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INCREASING READINESS AND PRODUCTION THROUGHPUT BY IMPROVING DEFENSE LOGISTICS AGENCY (DLA) CONSUMABLE ITEM AVAILABILITY

by

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A Research Report Submitted to the Faculty

In Partial Fulfillment of the Graduation Requirements

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Last, thank you Major Robert Moriarty. You were an outstanding advisor.

Abstract

. This research revealed that between Oct 00 and Nov 01, 49% (54 million) of the AF MICAP hours were for DLA managed items. DLA items had an average unit price per MICAP incident of $1,028 and an average unit price per MICAP hour of $4.50. For DLA items, 10% of the MICAP hours were for items costing less than $10, while 28% were for items that cost less than $50 and 86% of the MICAP hours were for items that cost less than $2,500. Furthermore, of the DLA items that had MICAP hours, 32% of the items are needed in aircraft, engine and accessory production processes. Last, stratifying the DLA records by AAC Code revealed that potentially 25% of the projected DLA sales are for items that DLA does not have stock on hand. In deriving these results, the research integrated 2.7 million records from the MICAP, EXPRESS, DLA, SBSS and G005M systems. Seventeen AF weapon systems accounted for over 84% of the MICAP hours between Oct 00 to Nov 01. DLA provided files for these 17 weapon systems comprised of over 400,000 unique items projected to generate $700 million in sales per quarter—$2.8 billion for FY02. The AFLMA and OC-ALC provided complementary data that facilitated building a system view of each item. In total, this research found the same NIINs that cause MICAPs at bases also impact depot production. The research illustrated that managers can correlate the unit price of an item to the impact it has on support processes. The research concluded by identifying conditions that may cause future MICAPs and degrade production processes.

Chapter 1

I. Introduction

Background

Since its creation in 1961, DLA has grown to become a worldwide logistics combat support operation…It supplies almost every consumable item America's military services need to operate, from groceries to jet fuel. In short, if America's forces can eat it, wear it, drive it, shoot it, or burn it, chances are that DLA helps provide it.

DLA Brochure[1]

What Is a Consumable Item?

By definition, consumable items possess two distinguishing characteristics: first, they are generally one of many components that comprise a complex part, and second, when the component fails, it is often disposed of—since it is not economical to repair.[2] By 1995, the Defense Logistics Agency (DLA) had assumed management responsibility of more than 4 million consumable items in support of the DoD.[3] Today, DLA manages over 930,000 aviation related consumable items.[4] On a daily basis, AF bases around the globe and the three remaining AF production depots order DLA-managed consumable items. The AF depots--Oklahoma City (OC), Ogden (OO), and Warner Robins (WR)--use those items to overhaul aircraft and engines or refurbish accessory components in support of anticipated AF base, sister service, or Foreign Military requirements. AF base maintenance processes use DLA-managed items, thus ensuring weapon systems are available to perform their missions. As Figure 1 illustrates, DLA-managed items--often referred to as "bits n' pieces"--are used throughout the AF multi-echelon repair and support process. Consequently, DLA-managed items play a major role in AF readiness.

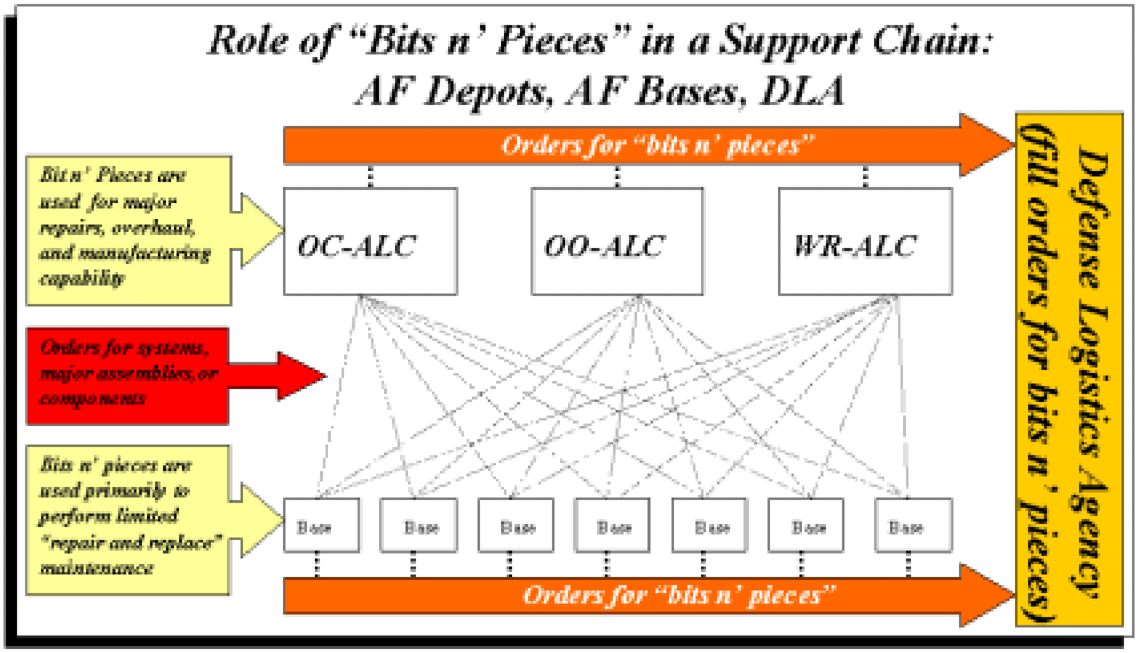

Figure 1. Role of "Bits n' Pieces" in a Support Chain: AF Depots, AF Bases, DLA

As the figure depicts, virtually every AF maintenance, production, or support process relies on the availability of DLA managed items. Beginning with the AF depot, what are the potential impacts of not having a DLA managed item?

What Happens When an AF Depot Does Not Have a Consumable Item?

AF depots use consumable items to overhaul aircraft and engines and to repair accessories. Aircraft and engine overhaul processes may require the completion of thousands of operations and generally follow a maintenance plan that may take from several months or more than a year to complete. Consequently, not having a consumable part may suspend one or many operations and thereby, suspend or delay several follow-on processes. Conversely, repairing an accessory item generally takes several hours or days and requires significantly fewer maintenance operations. Before initiating the repair process for an accessory item, the AF depot's automated induction process, EXPRESS, determines if needed bits n' pieces are available to repair the accessory. If the needed bits 'n pieces are available, the depot inducts the item—i.e. routes the defective item to the appropriate shop for repair, allocates manpower and machine time for the repair of the accessory, etc. Figure 2 depicts the induction decision process.

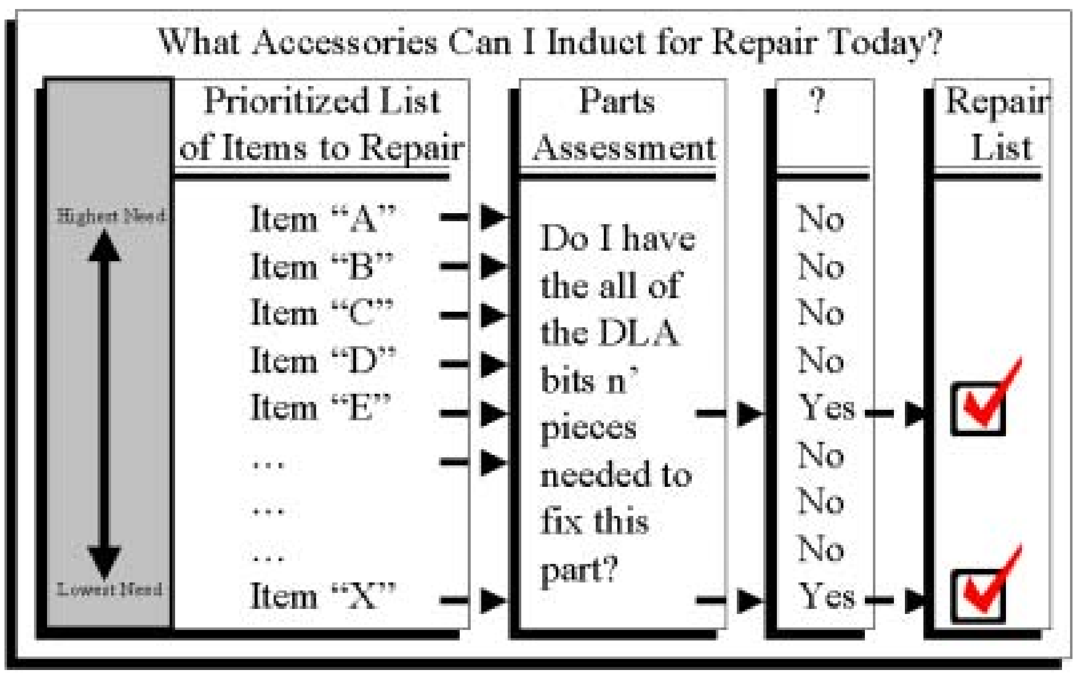

Figure 2. What Accessories Can I Induct For Repair Today?

As Figure 2 illustrates with "Item A", EXPRESS will not induct the most needed item if there are not sufficient bits n' pieces to perform the repair. Consequently, lower priority items may be repaired instead of higher priority items. This ripple effect may cause delays in the repair of items that are MICAP at a base. Table 1 lists potential impacts when a depot does not have a DLA managed bit n' piece needed for a repair process. However, depots are not the sole consumers of DLA consumable items. AF base maintenance processes also use DLA consumable items.

Table 1. What Happens When an AF Depot Does Not Have a Consumable Item?

Impact	*Aircraft*	*Engines*	*Accessories*
Increase the total amount of time to complete programmed depot maintenance	Yes	Yes	
Re-sequence thousands of repair operations when a repair operation cannot be performed as a result of not having needed bits 'n pieces	Yes	Yes	
Increase spares requirements for repair pipelines as a result of not having bits 'n pieces		Yes	Yes
Delay the repair of priority backorders while waiting for needed bits 'n pieces		Yes	Yes
Increase the likelihood of future critical backorders for the same items that are already MICAP		Yes	Yes
Increase the cost per item produced as a result of increased repair days (flow days)	Yes	Yes	Yes
Reduce the performance of the applicable stock fund as a result of not filling priority requests	Yes	Yes	Yes

What Happens When an AF Base Does Not Have a Consumable Item?

When an AF base does not have a consumable item on hand, and that item is required to repair a mission-essential weapon system, the base may submit a MICAP requisition for the needed item.[5] MICAP, meaning "Mission Capable", requisitions receive priority attention and resources throughout the logistics system. They represent requests for components or parts that will restore mission capability to a critical weapon system. Given the extremely urgent nature of a MICAP requisition, personnel complete several steps to ensure an item is not on-hand before submitting a MICAP requisition. Figure 3 lists several of those steps. MICAPs ground aircraft and render equipment unusable—they effectively disable a mission critical asset or function.

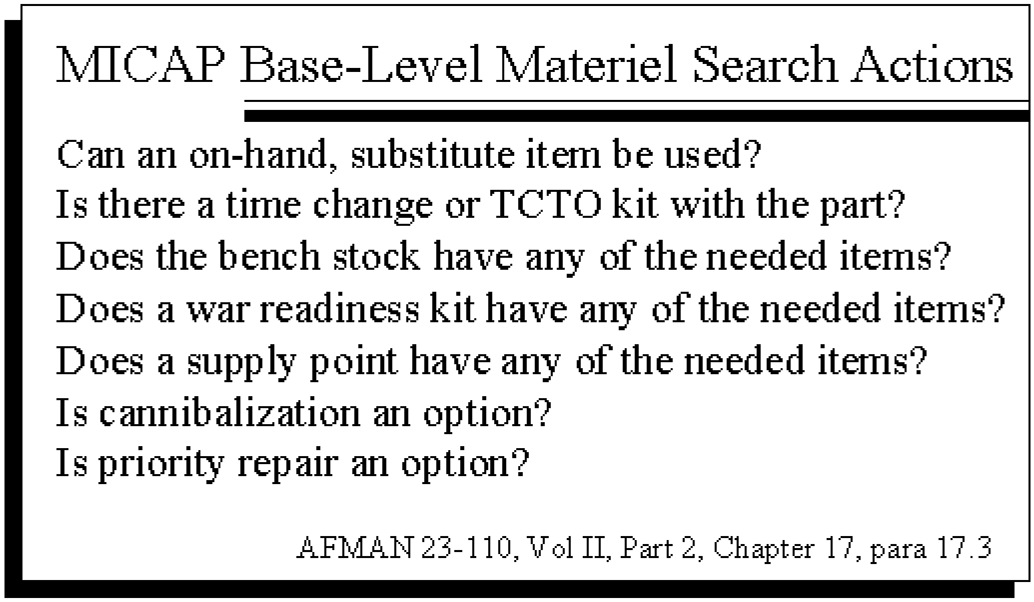

Figure 3. MICAP Base-Level Materiel Search Actions

The AF uses the D165B system to track MICAP requisitions and measure the amount of time that critical weapon systems and related equipment are incapacitated. D165B measures MICAP incidents in hours--from the day and hour a MICAP is started to the day and hour the MICAP is terminated. Because the clock never stops, MICAP hours accumulate over weekends, holidays, etc—until the request is satisfied or terminated.

In addition to performing research before generating a MICAP requisition, an AF base may expend resources to mitigate the impact of not having a consumable item. For example, after generating the MICAP requisition, thereby establishing an electronic request for a mission critical part, maintenance personnel may cannibalize the same part from another aircraft. Alternatively, a local manufacture process may attempt to replicate the needed part. Supply personnel may try to satisfy the MICAP request by requesting stock from another base. Figure 4 illustrates many of the actions an AF base may take to mitigate the impact of not having a consumable part.

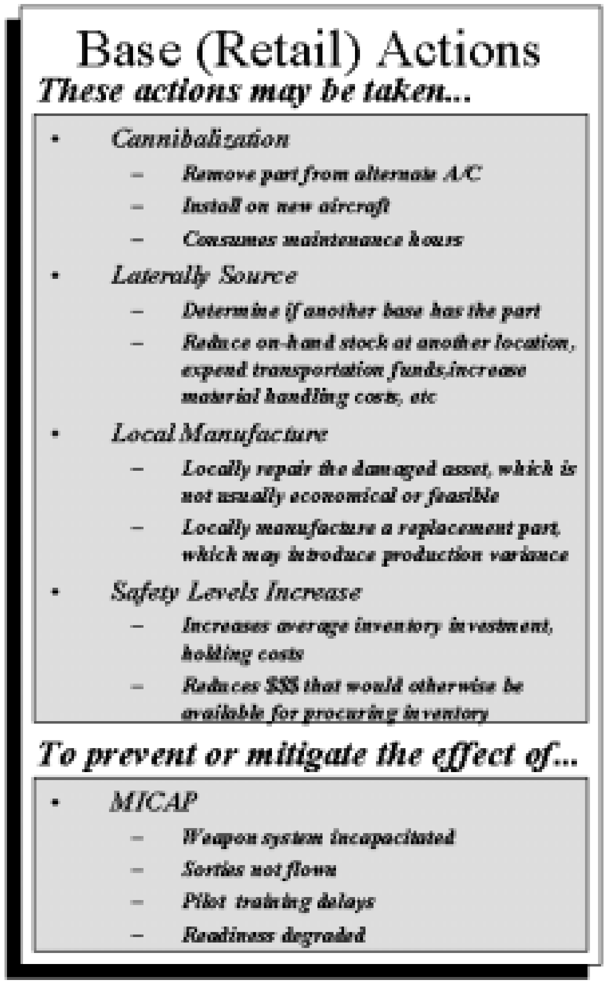

Figure 4. What Happens When an AF Base Does Not Have a Consumable Item?

Daily, AF bases and AF depots use DLA managed consumable items to perform maintenance and repair functions that ensure mission capability. Given this reliance on DLA managed items, what has been the impact to AF mission capability?

DLA-Managed Consumable Items—the Leading Cause of AF MICAP Hours

As Figure 5 illustrates, DLA-managed items caused the AF more than 3 million MICAP hours per month between Oct 00 and Nov 01. Significantly, the Systems

Management Analysis & Reporting Tool (SMART)[6] reveals DLA items outpace the second leading cause of AF MICAP hours by more than one million hours per month. The monthly labels on the chart indicate data is normally retrieved on the seventh day of each month to measure MICAP hours for the prior month. As an example, on 07 Nov 00, the MICAP hours were captured and measured for the month of Oct 00.

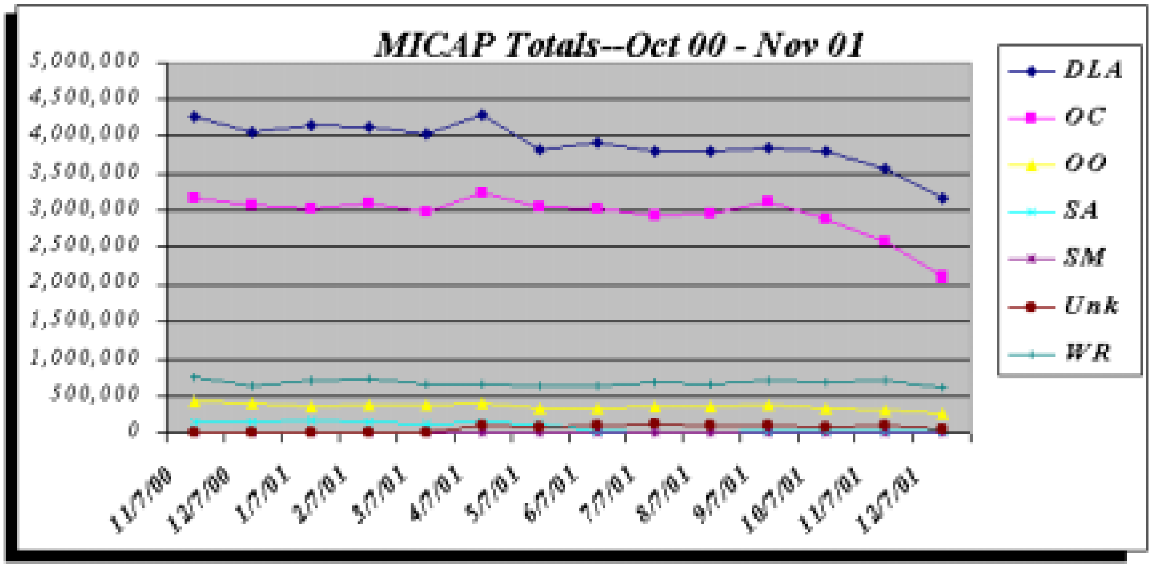

Figure 5. MICAP Totals—Oct '00 – Nov '01

As we see in Table 2, DLA-managed items accounted for more than 54 million of the 112 million AF MICAP hours recorded between Oct 00 to Nov 01—almost 49% of the total MICAP hours. Consequently, the data suggests that DLA-managed items have the greatest potential to increase AF readiness.

Table 2. AF MICAP Hour Totals From Oct 00 – Nov 01

Source of Supply	*Oct 00 - Nov 01 MICAP Totals*	*% of Oct 00 - Nov 01 MICAP Totals*
DLA (Defense Logistics Agency)	54,608,434	48.74%
OC-ALC (Oklahoma City ALC)	41,138,993	36.72%
OO-ALC (Ogden ALC)	4,991,034	4.45%
SA-ALC (San Antonio ALC)	1,069,683	0.95%

SM-ALC (Sacramento ALC)	27,348	0.02%
Unknown	758,109	0.68%
WR-ALC (Warner Robins ALC)	9,442,752	8.43%
Total Hrs	**112,036,353**	**100.00%**

Problem Statement…A Systems View

DLA-managed items cause approximately 49% of the total AF MICAP hours each month and thus, represent the greatest potential to increase AF weapon system availability. Furthermore, as Table 1 revealed, an item that incapacitates a weapon system may also degrade one or many wholesale production processes, thus potentially crippling both a weapon system and a support process. Therefore, Air Force Materiel Command (AFMC) and the DoD could benefit from automated processes capable of:

1. Identifying DLA-managed items that are incapacitating weapon systems
2. Identifying the extent of the impact a DLA-managed item may have on total system support
3. Identifying conditions that are likely to cause impacts that are not commensurate with the cost of an item.

Given the potential benefits of automating the identification of DLA managed items that constrain AF production and weapon system support processes, this research effort seeks to fulfill three primary objectives.

Research Objectives

This research had the following objectives:

1. **Objective:** Automate the identification of DLA items that contribute to the preponderance of weapon system non-availability.
   Rationale: This provides a starting point for improving weapon system availability and facilitates correlating the cost of an item with its level of degradation to readiness and weapon system availability. Managers can then determine if the level of degradation is commensurate with the cost of the item.
2. **Objective:** Automate the identification of wholesale production processes (i.e., aircraft production, engines, or accessories) that would be impacted by the non-availability of parts that were also contributing to weapon system non-availability.

Rationale: By determining if an item affects processes at multiple echelons, managers can assess if the sum of the impacts is proportional to the item's cost.

3. **Objective:** Automate the identification of conditions that are likely to generate MICAPs or have adverse impacts to support and production processes.
   Rationale: Managers can assess the affects of inventory policies and determine if they are commensurate with the level of degradation they potentially cause.

Organization of the Research

This chapter revealed that DLA managed items caused almost 49% of the AF MICAP hours during the period Oct 00 to Nov 01. As the primary cause of AF weapon system non-availability, DLA-managed items represent the greatest single opportunity for improving AF readiness. Furthermore, this chapter introduces the possibility that items grounding aircraft and incapacitating weapon systems may affect AF depot production processes. Finally, the research objectives provided the goals and rationale of this study.

Chapter 2 reviews the concept of the Acquisition Advice Code (AAC) and Economic Order Quantity (EOQ). Additionally, this chapter briefly discusses DLA policies, initiatives, and two AF Logistics Management Agency (AFLMA) logistics studies. Chapter 3 contains the detailed methodology employed in this research. The chapter presents additional considerations in the design of the research methodology and finally, the steps required for implementing the research design. Chapter 4 documents the research analysis and results. Lastly, Chapter 5 summarizes the results of the research and provides recommendations for senior management consideration.

Chapter 1. End Notes

1. DLA Brochure, http://www.dla.mil/DLAtrifold.pdf
2. AFMC Instruction 23-105, Part 1, Chapter 1, pg. 10, 1997
3. Robinson, Nathaniel, Maj., Research Report No. AU-ARI-92-4, *The Defense Logistics Agency, Providing Logistics Support Throughout the Department of Defense*, Maxwell AFB, Air University Press, October 1993, pg. xvii, 9
4. DLA Homepage, http://www.dla.mil
5. AFMAN 23-110, Vol. II, Part 2, Chapter 17, pg. 17-1. (Also see Appendix C. MICAP)
6. Systems Management Analysis Reporting System (SMART), OC-ALC Managed Data Warehouse and Application

Chapter 2

II. Literature Review

Overview

This chapter begins with a brief overview of the Acquisition Advice Code (AAC) and its relationship to stockage policy. Following the overview of the AAC is a discussion of DLA metrics and their congruency with AF readiness objectives and a DLA initiative to improve support to AF depots. Next, this chapter discusses the potential system support costs that are incurred as a result of MICAP incidents and the role base-level stock replenishment algorithms play in attempting to mitigate MICAP incidents and minimize costs. This chapter concludes with a review of two studies to improve the materiel support afforded by the base-level stock replenishment algorithm.

AF Logistics…Minimizing the Sum of System Support Costs?

> *Sometimes called the layperson's description of logistics, the Seven Rs define logistics as "ensuring the availability of the right product, in the right quantity and the right condition, at the right place, at the right time, for the right customer, at the right cost.*
>
> Coyle, Bardi, Langley[1]

Chapter 1 alluded to several costs that are incurred when bits n' pieces are not in the right place, at the right time, in the right quantity. This section begins by discussing the role of inventory in the context of system support costs and then portrays the function of inventory as a mechanism to minimize total system support costs.

Role of Inventory in a Logistics System

> *Inventory exists because supply and demand are difficult to synchronize perfectly and it takes time to perform materiel-related operations…The objective of inventory management is to have the appropriate amounts of materiels in the right place, at the right time, and at low cost.*
>
> Tersine[2]

Inventory plays a major role in supporting AF readiness goals and objectives. AF depots and bases plus DLA all maintain inventories in anticipation of performing a production process or satisfying a request. By prepositioning or producing the right items, at the right place, at the right time, in the right condition, in the right quantities, the AF reduces the amount of time needed to replace defective parts or perform maintenance processes. DLA ensures the AF can perform its mission by stocking or obtaining the right items, at the right place, at the right time, in the right condition, in the right quantities. As reflected in the 54 million MICAP hours caused from Oct 00 to Nov 01, AF readiness is significantly degraded when a DLA bit n' piece is not in the right place, at the right time, in the right quantity. The next section discusses the role of the AAC in reflecting which items DLA stocks and under what conditions.

Acquisition Advice Codes (AACs)…Categorizing Support

"Acquisition Advice Codes indicate how (as distinguished from where) and under what restrictions an item will be acquired."[3] Consequently, the AAC often reflects whether a Source of Supply (SOS) maintains stocks of an item and the rationale for not keeping stock on-hand. For example, a SOS may not stock an item because it has become obsolete or condemned, or may be delivered directly to a customer from the manufacturing source. Table 3 lists the AACs and provides a short definition of each.[4]

Table 3. List of AACs and a Short Definition of Each AAC

AAC	AAC Description
A	Service Regulated
B	Inventory Control Point regulated
C	Service managed
D	DoD integrated materiel managed, stocked, and issued
E	Other service managed, stocked, and issued
F	Fabricate or assemble
G	GSA integrated materiel managed, stocked, and issued
H	Direct delivery under central contract
I	Direct ordering from a central contract/schedule item
J	Not stocked—long lead time
K	Centrally stocked for overseas only
L	Local purchase
M	Restricted requisitions—major overhaul
N	Restricted requisitions—disposal
O	Packaged fuels
P	Restricted requisitions—military assistance program
Q	Bulk petroleum products
R	Restricted requisitions—government furnished materiel
S	Restricted requisitions—other service funded
T	Condemned
U	Lead service managed
V	Terminal item—stock available
W	Restricted requisitions—special instructions apply
X	Semi-active
Y	Terminal item—no stock
Z	Insurance/numeric stockage objective item

For the purpose of this research, the most significant AACs are those most likely to impact supportability. For example, AAC "J" is significant because it has a long lead-time and it is not stocked. Therefore, whenever an AF base or depot places an order for an item that has an AAC "J", they can expect to wait a significant amount of time before receiving their order. Similarly, AAC "Y" items are not stocked since they have been designated as "terminal" (obsolete). In a different vein, AAC "Z" items represent a special category of items referred to as "insurance" items. These items "may be required occasionally or intermittently and prudence requires that a nominal quantity of materiel be stocked due to the essentiality or lead time of the item."[5] AAC "Z" items are normally critical to the operation of a weapon system and when DLA cannot fill an AF order for an AAC "Z" coded item, the weapon system that needed the bit n' piece is normally incapacitated. As this section highlights, the AAC reflects which items are normally stocked and under what conditions. This information proves useful when determining why an item causes MICAP hours or impacts depot production.

DLA: The Lynchpin in Consumable Support

As the primary provider of over 930,000 different aviation bits n' pieces to the AF, DLA support represents a significant component of AF readiness potential. With the ability to affect AF base-level maintenance and depot-level production, DLA management practices have significant consequences to AF processes. This section discusses the relationship between DLA metrics and the AF and a current DLA initiative to improve support to AF bases and depots.

DLA Metrics…Are They "AF Readiness" Oriented?

> *Department of Defense Reform Initiative Directive (DRID) #54 requires components to develop a logistics transformation plan that supports attaining the objectives of the Depart of Defense Logistics Strategic Plan…DLA is in the process of developing a balanced scorecard approach to strategic performance measurement…It is our intention to base the DLA Performance Contract for Fiscal Years 2002-2007, and beyond, on the strategic performance measures generated by the balanced scorecard development process.*
>
> Henry T. Glisson, Lieutenant General, USA, Director of DLA[6]

The plan attached to the 28 June 2000 Logistics Transformation Plans memorandum of DLA Director Lt Gen Glisson is designed to support the DoD Logistics Strategic Plan objectives.[7] Table 4 lists the DoD Logistics Strategic Plan Objectives.

Table 4. DoD Logistics Strategic Plan Objectives

Objective #	***Objective***
1	Optimize Support to the Warfighter
2	Improve Strategic Mobility to Meet Warfighter Requirements
3	Implement Customer Wait Time as the DoD Logistics Metric
4	Fully Implement Total Asset Visibility Across DoD
5	Reengineer/Modernize Applicable Logistics Processes/Systems
6	Minimize Logistics Costs While Meeting Warfighter Requirements

The DLA transformation plan metrics link to their performance contract. Concerning this research, the most relevant DLA metrics support optimizing warfighting support while minimizing logistics costs—objectives 1 & 6. Table 5 contains two DLA Performance Contract metrics that seek to optimize warfighter support at reduced costs.

Table 5. DLA Performance Contract Metrics Listed in the DLA Transformation Plan That Supports the DoD Strategic Logistics Plan

DLA Performance Contract	***DLA Strategic Plan***	***DoD Strat Plan Obj #***
8. Deliverable: Aggregate supply availability for all weapon system items will be equal to or greater than 85 percent for each military service for each fiscal year.	Goal 1: Consistently provide responsive, best value supplies and services to our customers. Objective 1.1: Meet customer expectations of quality, timeliness, information, and performance	1
19. Deliverable: Using best practices, reduce non-energy inventory to the following levels each fiscal year. FY00 FY01 FY02 FY03 FY04 FY05 Inventory Levels ($M) 7,035 6,764 6,483 6,165 5,849 5,534	Goal 2: Reduce costs—improve efficiency—increase effectiveness Objective 2-3: Implement commercial business-based systems and practices	6

Deliverable 8 of the DLA performance contract promises to provide an aggregate AF supply availability rate of 85 for AF weapon systems. Expressed another way, 85% of the time the AF requests weapon system bits n' pieces, DLA will have the part in stock and issue it to the respective AF customer. On the surface, this metric may look appealing. However, the metric does not link DLA supply availability to AF readiness. Instead, the metric implies that DLA 85% supply availability will support AF readiness and production objectives. As shown in chapter one, 49% of the AF weapon system incapacitation is due to the lack of DLA bits n' pieces. Figure 6 depicts the DLA supply availability rates in support of the AF from Aug '00 – Oct '01.

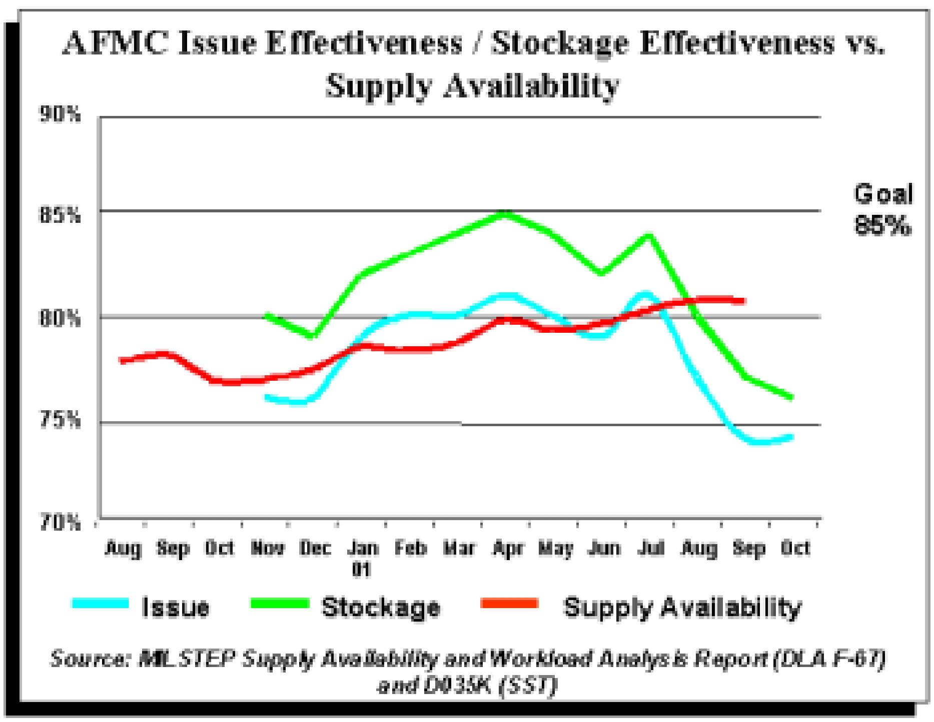

Figure 6. DLA-Provided Supply Availability Trend Chart

In this case, DLA has been supporting requests from AFMC's retail supply operations at an increasing rate. However, this mix of parts AFMC's retail supply operations requisitioned from DLA did not result in a corresponding increase in support for their customers. Looking at the supply availability metric alone gives the impression that support for the

> *maintainer should be getting better. However, the issue and stockage effectiveness numbers show that support to the maintainer plummeted in August and September.*
>
> Lieutenant Colonel Bradley Silver[8]

Correspondingly, Chapter 1 revealed that from Oct '00 to Nov '01 (depicted in Figure 5), DLA managed items outpaced the next leading cause of MICAP hours by more than one million hours per month. Most importantly, the 85% supply availability metric does not reflect the degree of readiness AF weapon systems can expect to maintain. In short, a supply availability metric of 85% assumes that if this measure is in the right range, readiness will take care of itself.[9]

Deliverable 19 (listed in Table 5) of the DLA Performance Contract indicates DLA should seek to reduce inventory from \$7.0 – \$5.5 billion during FY00 to FY05. This \$1.5 billion decrease represents significant risk to production and support processes. A 1990 Logistics Management Institute (LMI) report noted the following:

> *One of our central findings is: for the demand-based items the Air Force has placed in DLA's Weapon System Support Program (WSSP), a one-time 20 percent (\$50 million) reduction in DLA wholesale safety levels would—through the increased depot delay that reduction would impose on Air Force bases—ground or render PMCS an additional 30-40 aircraft beyond the roughly 1,300 aircraft already NMCS or PMCS at any given time among the total Air Force fleet of 9,100.*
>
> Christopher H. Hanks[10]

Consequently, reducing inventory represents significant risk to maintaining AF readiness.

This section suggests that DLA Performance Contract metrics are not linked to AF readiness measures. Furthermore, reductions in DLA inventory, particularly safety level stocks, represent significant risk to AF readiness. As such, the AF should understand the range of items targeted through DLA inventory reduction initiatives and their potential impact to AF readiness and production processes. The next section briefly discusses a DLA initiative to improve supportability to the AF.

DLA Defense Management Review Team (DMRT)…Issue 3

DLA is currently addressing the issue of increasing support to AF needs. A DLA DMRT has identified several issues that could improve DLA support to the AF. In particular, Issue 3 of the DLA DMRT is titled "DLA support to the ALCs hinders their ability to support the warfighter". This issue addresses support to AF depots. The DMRT noted that 86% of AF depot parts requests are for DLA-managed items and that issue and stockage effectiveness for those items ranges from 78-82%—vs. an industry benchmark of 95%.[11] The DMRT highlights inaccurate forecasting as a major contributor to this condition and notes that actual increases in demand are within ± 50% of forecasted values in just 16% of cases.[12] Figure 7 lists actions the DRMT is currently seeking to undertake in efforts to improve support to AF depots.

DLA DMRT ACTIONS

-Reduce excessive ALT/PLT and procurement backlog*
-Contracted support to work off backlog
-Expand use of strategic supplier alliances
-Leverage product families (bushings, tubes, etc.)
-Improve AF/DLA communication and collaborative demand forecasting
-Reassess ownership of DLA distribution function at the ALCs
-Accountability, authority, and responsibility not aligned to the center commander
-DLA information systems policies (batch mode) not responsive to warfighter and EAF environment

** ALT -- Administrative Leadtime* ** PLT -- Procurement Leadtime*

Figure 7. DLA DMRT…Current Actions to Resolve Issue 3

This section highlighted a current initiative by DLA to improve support to AF depots, and subsequently, AF bases. As the concluding section of this literature review, the following section discusses AF algorithms and the role they play in attempting to minimize system support costs while optimizing weapon system readiness.

AF Retail Requirements Algorithms and Analyses

This section discusses two prominent models the AF uses to determine how much consumable stock to requisition from DLA and when to place a requisition. In addition, this section highlights the costs that AF retail algorithms are designed to balance or minimize. Last, this section briefly discusses two consumable studies that reviewed the relationship between DLA and AF retail ordering procedures.

Basic Consumable Item Requirements Theory

Consumable items that qualify for a demand level in the AF retail Standard Base Supply System (SBSS) generally use a derivative of the Wilson Lot Size formula[13] for determining the optimal reorder quantity. The basic EOQ model[14] is as follows:

$$EOQ = \sqrt{\frac{2 * 365 * DDR * CosttoOrder}{HCF * UP}}$$

Table 6 lists the basic components of the EOQ model and constant values the AF has substituted for the holding and ordering cost data elements.[15]

Table 6. Data Elements of the EOQ Model

Data Element	Data Element	Definition	AF Constants
R	Annual Demand	The total annual demand in units (DDR*365)	N/A
2	Constant	N/A	N/A
365	Constant	The number of days in a year	N/A
CosttoOrder	Cost to Order	"Represents the total cost to process stock replenishment orders."[16]	$5.20 for DLA managed items
DDR	Daily Demand Rate	"Represents the average quantity of an item that is used daily."[17]	N/A
EOQ	Economic Order Quantity	"The order size that minimizes the total inventory cost."[18]	N/A
HCF	Holding Cost Factor	The annual holding cost as a fraction of the unit price	15% (.15)
UP	Unit Price	Price of the item being reordered	N/A

Figure 8 depicts the two annual cost functions that the EOQ is attempting to minimize—annual ordering and holding costs. As Figure 8 depicts, the reorder quantity represents the point at which expected annual ordering costs are equal to expected annual holding costs. The point at which these two cost functions intersect minimizes the expected total annual variable costs related to ordering and holding inventory.[19]

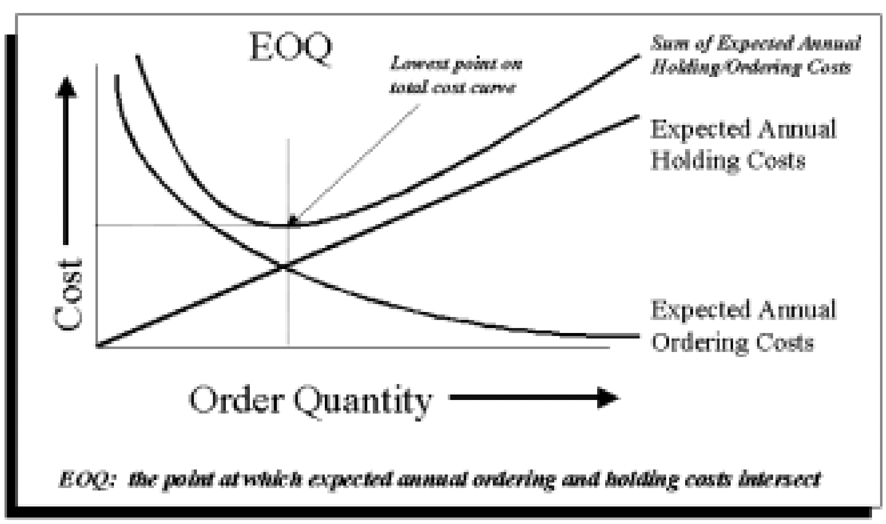

Figure 8. EOQ…Minimizing the Expected Annual Holding & Ordering Costs

For the EOQ model to truly minimize expected annual variable costs related to holding and ordering inventory, there are several assumptions which must be adhered to. Figure 9 lists the assumptions of the EOQ model.[20] The most critical assumption of the EOQ model is that it presumes that demand is constant and continuous. However, a 1974 study by the Air Force Academy, a 1985 study by the AFLMA, and a 1995 AFIT thesis all reveal that AF ordering practices violate this assumption.[21] By not placing orders at constant intervals for a constant quantity, it becomes less likely the AF is achieving its objective of minimizing annual inventory ordering and holding costs. Furthermore, other assumptions of the EOQ model also become suspect.

Assumptions of the EOQ Model

1. The demand rate is known, constant, and continuous
2. The lead time is known and constant
3. The entire lost size is added to inventory at the same time
4. No stockouts are permitted; since demand and lead time are known, stockouts can be avoided
5. The cost structure is fixed; order/setup costs are the same regardless of lot size, holding cost is a linear function based on average inventory, and unit purchase cost is constant (no quantity discounts)
6. There is sufficient space, capacity, and capital to procure the desired quantity
7. The item is a single product; it does not interact with any other inventory items (there are no joint orders)

Tersine, *Principles of Inventory and Materials Management*, 1994, pg 94

Figure 9. Assumptions of the EOQ Model

In addition to the assumptions listed in Figure 9, there is an assumption that by minimizing the sum of variable inventory ordering and holding costs, total system support costs are also minimized. Figure 10 depicts this assumption. However, this literature review contains insufficient evidence to determine if this assumption is valid.

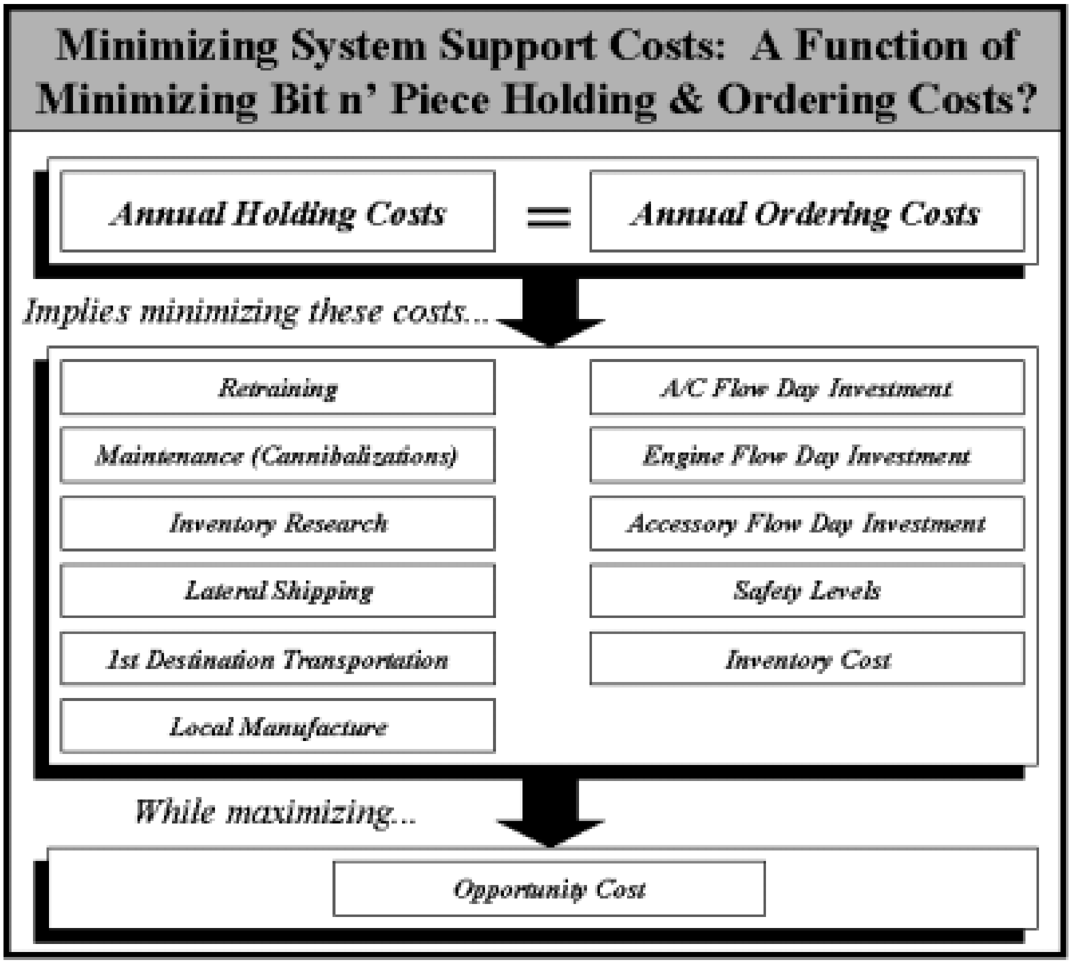

Figure 10. Minimizing System Support Costs—A Function of Minimizing Bit n' Piece Holding and Ordering Costs?

Just as important as the reorder quantity is the reorder point—the point at which replenishment stock is ordered. The AF SBSS primarily uses the following equations to determine the reorder point for items requisitioned from DLA:

$$Consumable\,ReorderPoint = SLQ + O\&STQ$$

Where,

$$SLQ = \left[C\sqrt{(O\&ST * VOD) + (VOO * DDR^2)}\right]$$

And,

$$O\&STQ = O\&ST * DDR$$

Table 7 defines the variables that are in the Consumable Reorder Point computation.[22]

Table 7. Safety Level Quantity Variables

Data Element	Data Element	Definition
C-Factor	Standard Deviation	Represents the number of standard deviations of safety stock to be included in the reorder point. The higher the number of standard deviations of safety stock, the less likely it becomes there will be a stockout during the replenishment order cycle.
DDR	Daily Demand Rate	"Represents the average quantity of an item that is used daily."[23]
O&ST	Order & Ship Time	"The average number of days between the initiation and receipt of stock replenishment requisitions."[24]
O&STQ	Order & Ship Time Quantity	Quantity required to be on hand to meet demands during the O&ST.[25]
SLQ	Safety Level Quantity	"Represents items that are required to be on hand. These items allow continuous operation of a base mission when demand levels are not adequately restocked or increase unpredictably."[26]
VOD	Variance of Demand	Uses the standard statistical formula for variance to compute the variance of units requested per customer order.
VOO	Variance of Order & Ship Time	Uses the standard statistical formula for variance to compute the variance of days per stock replenishment requisition.

The Reorder Point represents the quantity of on-hand stock at which an order must be placed to assure continuous supply support for a given item. The O&STQ represents the expected demand (in units) at a location during the replenishment period. The SLQ represents a safeguard to protect against variance in customer demand patterns or transportation lead times. The sum of the O&STQ and SLQ represents the number of units of stock that should be on hand when a request for the EOQ is submitted to DLA.

At the time the AF SBSS places an order for a DLA managed item, it makes a cost trade-off determination. A potential reduction in safety level stock is balanced against the increased costs for premium transportation if the order is expedited. The AF SBSS uses the following algorithm to determine whether to expedite a routine stock replenishment requisition with premium transportation.

$$\frac{\text{One - time Reduction in Inventory Value Resulting From Fast Trans}}{\left(\text{Annual Increased Cost of Fast Trans}\right)-\left(\text{Annual Decrease in Holding Cost from Fast Trans}\right)}$$

or, symbolically,

$$\frac{Unit\,\mathrm{Pr}\,ice*(SLQ_{SLOW}-SLQ_{FAST})}{\left[\left(\frac{365*DDR}{EOQ}\right)*(Trans_{\mathrm{Pr}\,em}-Trans_{Rout})\right]-\left[(Unit\,\mathrm{Pr}\,ice)*(HoldCostFactor)*(SLQ_{SLOW}-SLQ_{FAST})\right]}$$

Appendix F provides more information regarding the data elements and the meaning of each of the components. However, the most significant aspect of the model at this point is that it introduces a new variable cost to consider—transportation costs.

This section discussed two major concepts. When ordering DLA bits n' pieces, AF SBSS algorithms balance—or trade-off—holding, ordering, and transportation costs in an attempt to minimize total system support costs. Also, this section lays a foundation for understanding that the item's safety level, and thus, its reorder point, is designed to protect against variability in customer demands and O&ST while a replenishment requisition for stock is being filled.

Two Air Force Logistics Management Agency (AFLMA) Consumable Policy Studies

In 1997, the AFLMA produced two reports that analyzed AF base and depot ordering practices and provided recommendations to alter AF ordering practices as a means of improving DLA support to AF requests.

AFMLA Final Report LS199718904 concluded that the AF could benefit from placing smaller, more frequent orders to DLA—primarily for items costing more than $125. Furthermore, by increasing the C-Factor, thereby increasing the Safety Level and the Reorder Point, greater protection is afforded against demand variability and DLA order and ship times. Last, the report suggested that if bases order AAC "Z" and "J" items more frequently, DLA support could increase support for those items.[27]

AFLMA Final Report LS199718901 analyzed demand levels with a reorder point of zero and assessed the affect of increasing the reorder point to one. In general, the report found that some items would benefit from having a reorder point adjusted to one (i.e., items that were used approximately four or more times a year and cost less than $1000).[28]

In total, these two reports suggest that increasing the safety levels and reorder points will afford greater protection from demand variability and DLA order and ship times.

The literature review discussed the importance of the AAC and its usefulness in determining why an item is MICAP or is affecting depot production processes. Next, this chapter discussed DLA support metrics and re-identified an issue that was noted in 1990—the DLA supply supportability metric may not be consistent with AF readiness goals. Concurrently, a DLA DMRT issue revealed that DLA is attempting to improve support to AF depots. Last, this chapter reviewed AF SBSS algorithms and their function in minimizing variable support costs. The AF SBSS attempts to minimize inventory, ordering, holding and transportation costs each time it submits a requisition to DLA. The literature review raised the concern that as a result of violating the primary assumption of the EOQ model, that demand be constant and continuous, total system support costs may not be minimized. Two AFLMA studies suggested that selectively increasing reorder points and safety levels could increase customer supportability. The next chapter outlines the methodology of this research.

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Chapter 3

III. Methodology

Overview

This chapter discusses the methodology employed in completing this research. The first section discusses the research design and two important concepts—relational database design and archival analysis. This section also lists and defines the sources of data used in the research. The second section of this chapter discusses the major limitations of the research. The chapter concludes by listing the research objectives.

Research Design

This research sought to compile and analyze data from several systems. The D165B system captures MICAP hours by weapon system and lists the items responsible for each MICAP. Concurrently, the AF performs wholesale production processes that may require the same items being reported MICAP. The AF G005M system contains Bills of Materiel (BOMs) that list the bit n' pieces required for aircraft and engine overhaul and repair processes. Similarly, the AF secondary item induction system, EXPRESS, contains a BOM file which lists each of the bits n' pieces that may be needed to repair an accessory. The research incorporated representative samples of data from each of these systems. Lastly, the research included data from DLA for weapon systems that had the most

MICAP hours caused by DLA-managed items. After obtaining these data sets, the research process then incorporated relational database techniques and archival analysis to investigate the research objectives. The ensuing sections explain these concepts.

Relational Modeling Techniques…Building a Supply Chain View

The research used the Microsoft (MS) Access '97 database application to store and analyze data. As outlined in the MS Access '97 on-line help and depicted in Figure 11, building a database is a multi-step process.[1] The research followed this prescriptive information in developing the database used for this analysis.

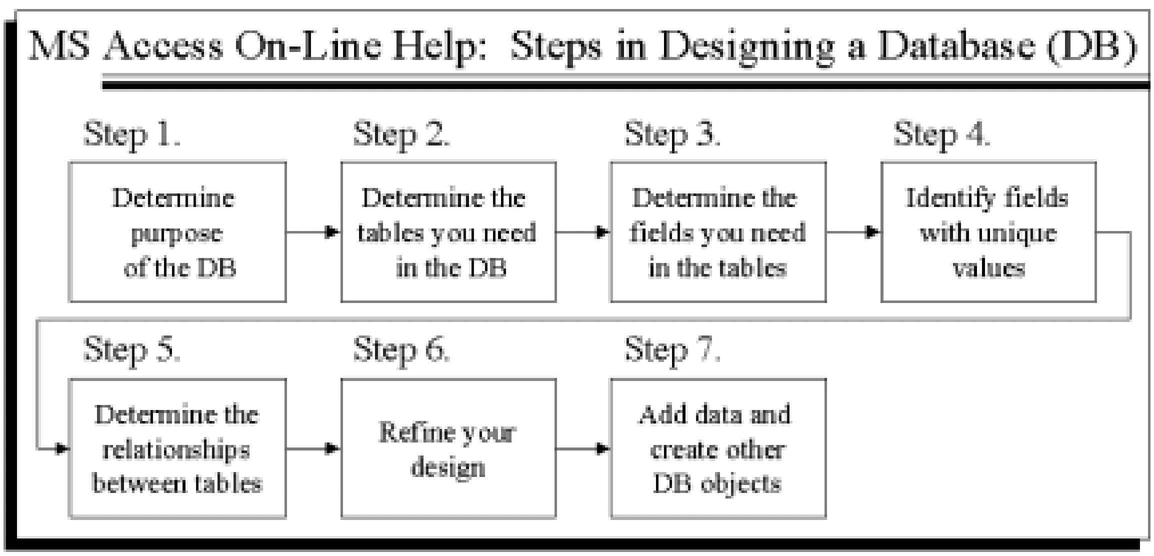

Figure 11. MS Access On-Line Help: Steps in Designing a Database (DB)

Step 1. The research objectives satisfy the intent of Step 1. For example, this analysis seeks to determine if relationships exist between items that are incapacitating weapon systems and those items used in AF depot production processes.

Step 2. Tables or databases from existing AF and DLA systems were identified to complete this research. As depicted in Figure 12, this analysis used data from five sources—DLA, D165B, SBSS, G005M and EXPRESS.

Support Process	*Area Impacted*	*System / Tables*
DLA	Requirements & Assets	**DLA Data** tbl_DLA_Data tbl_DLA_WeaponSystemCodes
Retail	Mission Impact	**D165B (MICAP)** dbo_MICAP
	Inventory Impact	**SBSS (O&ST/SLQ)** tbl_Retail_Data
Wholesale	A/C & Engine Production Lines	**G005M** tbl_G005M_04_Records tbl_G005M_09_Records tbl_G005M_23_Records
	Accessory Production Lines	**EXPRESS** dbo_indenture dbo_bill_of_materials dbo_spt_results

Figure 12. Determine the Data and Tables for the Database

Step 3. Designing a database entails listing and creating the data fields for the database. To create an audit trail of the data provided by AF and DLA systems, the DB design re-used the data fields and definitions of the source that provided the data.

Step 4. Define unique data elements in the tables. This step determines how well the research can accomplish Step 5—defining relationships between tables. The National Item Identification Number (NIIN), which possesses the uniqueness of an individual's Social Security Number, was the primary data element used to relate item information in one table to data in another table for that same item.

Step 5. Define relationships between tables. Figure 14 depicts how the NIIN was used to relate data from disparate domains and model relationships from disparate tables.

By linking the NIIN field from one table to the NIIN field in another table, queries are able to consolidate the information from two tables for a NIIN that exists in both tables.

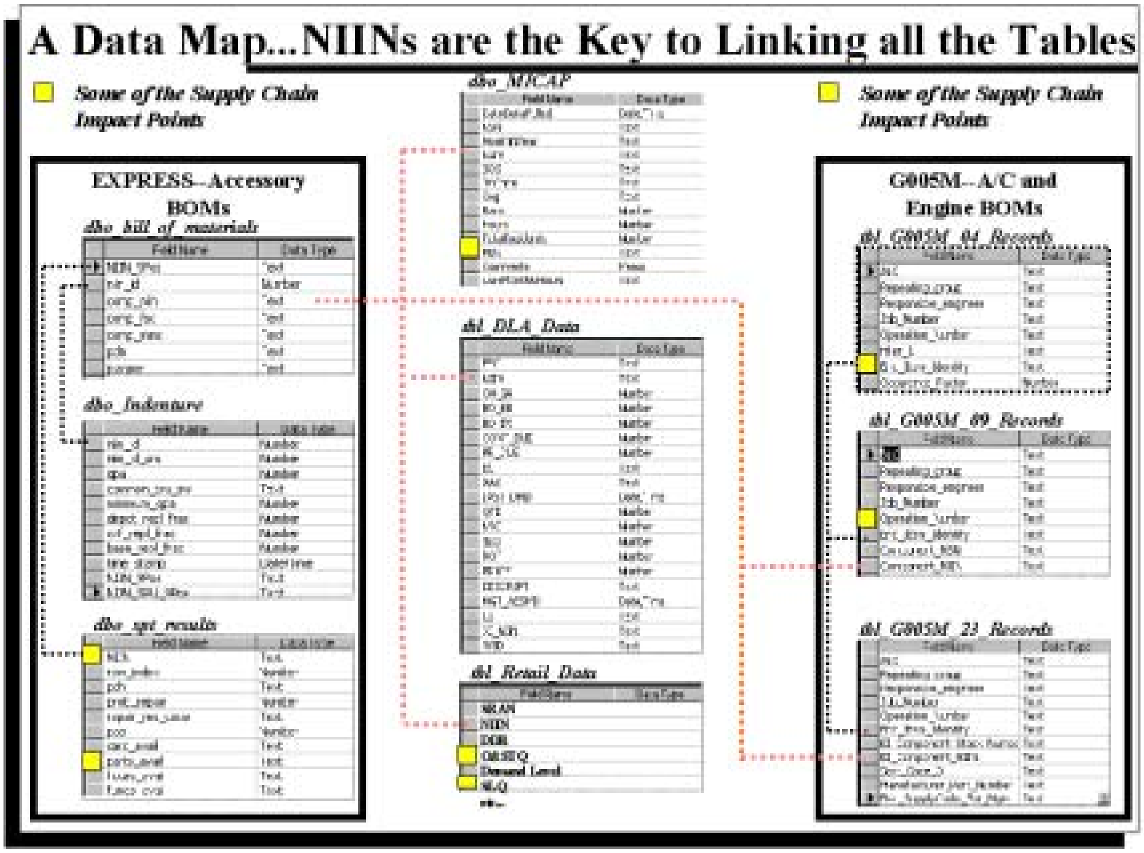

Figure 13. A Data Map—NIINs are the Key to Link all the Tables

Step 6. Refine the design. Since the database design used the data definitions of each contributing data source, this step was not used.

Step 7. Add data and create other database objects. First, this step entailed importing data from DLA, D165B, SBSS, G005M and EXPRESS files into the applicable MS Access tables. Once all the data was imported, new database objects, such as queries and forms, were designed to relate data from one table to data in another table. Determining if relationships exist between these data domains begins the archival analysis process.

Archival Analysis…a Data Systems Approach

The research incorporated 2.7 million records from the MICAP, EXPRESS, G005M, SBSS, and DLA systems. Table 8 lists the data files and record counts for each contributing organization or system.

Table 8. Data Files Imported Into the Research Database

Organization	Data Source	Record Count	Record Count Sub-Totals
DLA	***Weapon System Records and Codes***		**716,874**
	tbl_DLA_Data	716,841	
	tbl_Weapon_System_Codes	33	
OC-ALC	***MICAP, EXPRESS, BOM Records***		**1,621,620**
	dbo_MICAP (MICAP)	67,981	
	dbo_BOM (EXPRESS)	174,381	
	dbo_Indenture (EXPRESS)	20,723	
	dbo_spt_results (EXPRESS)	35,914	
	G005M_04_records (G005M-BOM)	21,497	
	G005M_09_records (G005M-BOM)	458,720	
	G005M_23_records (G005M-BOM)	842,404	
AFLMA	***Base Level Data (SBSS)***		**433,818**
	tbl_Retail_Data_History (30 Sep 01)	213,243	
	tbl_Retail_Data (31 Dec 01)	220,575	
Total			**2,772,312**

After importing the data into the applicable tables, the research process could incorporate the relational database techniques described in the previous section to investigate the research objectives. By considering each table as a separate data archive, database tools could query and analyze each table for specific conditions. In total, the database tables comprised a system of data. Every table possessed a relationship to every other table in the database and MS Access tools facilitated modeling and analyzing the potential relationships between the database tables.

Lastly, a summary archival table was developed that lists each MICAP item analyzed in the research and displays the associated indicative or summary information from each of the data sources for that item. This summary table demonstrated the potential of assimilating disparate data sources and the value of creating a system view for an item.

The Data Used In This Research

Tables 9 through 13 list the data sources assimilated for this research and includes a brief rationale for the use of the data. Each table also quantifies the population of items by data source and provides insight into how representative each sample of data may be.

Table 9. MICAP System (D165B) Data Used In This Research

System		**Narrative**
MICAP (D165B)	**Data**	MICAP hours and incidents by stock number, by Mission Design Series
	Purpose	Quantifies the retail operational impact of not having a DLA managed consumable item
	Data Used in the Research	May 01 – Nov 01. All DLA-managed items that had MICAP hours during this time frame
	# Items	35,097 items representing 77 Mission Design Series (MDSs)--(a table of the 77 MDSs is in Appendix D, Data)
	Reference	http://www.wsmis.day.disa.mil/ or contact by DSN 674-0166 or COMM: (937)904-0166

Table 10. DLA Data Used In This Research

System		**Narrative**
DLA	**Data**	Weapon System files
	Purpose	Contains inventory levels, forecasted demand rates, backorder data, contract and purchase request data, etc
	Data Used in the Research	The 17 highest-ranking MDSs which represented 85.48% of the total MICAP hours
	# Items	424,169 items, representing 17 MDS. Included the bits n' pieces used on the MDS and its related equipment.
	Reference	N/A. Contact DLA for further information.

Table 11. Depot Maintenance Materiel Support System (G005M) Data Used in This Research

System		**Narrative**
G005M	**Data**	Aircraft & Engine Bill of Materiel files
	Purpose	Contains the relationship between a major end-item, such as a weapon system and the bits 'n pieces used in the overhaul and repair process of that major end item. Also contains the accessories used in the overhaul of a major end item—like an aircraft of engine.
	Data Used in the Research	Complete G005M files for Oklahoma City (OKC) and Ogden (OO) Air Logistics Centers; the research does not include Warner Robin's G005M file.
	# Items	OKC file: 2,384 End Items, comprised of 79,394 component NIINs used in the repair of those End-Items OO file: 3,185 End Items, comprised of 63,027 component NIIN used in the repair of those End-Items In total: 135,987 unique component NIINs
	Reference	AFMCMAN 21-5, Depot Maintenance Material Support System G005M Users Manual

Table 12. EXPRESS Data Used In this Research

System		**Narrative**
EXPRESS	**Data**	Accessory Indenture File, Accessory Bill of Materiel File, Accessory Supportability Summary
	Purpose	These files list the bit n' piece NIINs used to repair an accessory. In addition, these files list the accessories the automated induction system attempted to allocate to repair for a specific day. As such, it is possible to determine which items were not inducted because there were insufficient bits n' pieces to repair the accessory and which items could have been impacted by a lack of insufficient bits n' pieces--but were not inducted because of a lack of carcasses or manpower
	Data Used in the Research	Only files from Oklahoma City Air Logistics Center; the supportability summary was for 06 Dec 01
	# Items	The Bill of Materiel file contains 2,037 accessories that may require any one or combination of 55,022 component NIINs to repair a given accessory. The Supportability file for the 06 Dec 01 day was comprised of 2,354 accessories which may have required any one or combination of 26,617 different component NIINs to repair those accessories on that day.
	Reference	EXPRESS Homepage: https://hqexpress01.day.disa.mil/ or contact by DSN: 787-5270 or Comm: (937)257-5270

Table 13. SBSS Data Used In This Research

System		**Narrative**
SBSS	**Data**	Contains the daily demand rate (DDR) and inventory balance of a component NIIN--by AF base--as of 30 Sep 01 and 31 Dec 01.
	Purpose	The analysis process can determine the total asset position for a given component NIIN, where there may be distribution problems and/or universal stock-outs, and how the total AF consumption rate compares to the DLA forecasted consumption rate
	Data Used in the Research	AF bases generated MICAP requests for 31,672 different DLA-managed items between Oct 00 to Sep 01. From this list, the AFLMA was able to retrieve DDR and inventory balance data for 26, 357 items (82.9% of the items were in the AFLMA database)
	# Items	26,357 unique items, used at 79 AF bases
	Reference	AFMAN 23-110, Vol II, Part 2

Alternatively, Figure 14 clearly models the relationships between these data sets. A question mark represents an unknown relationship—it may, or may not, exist.

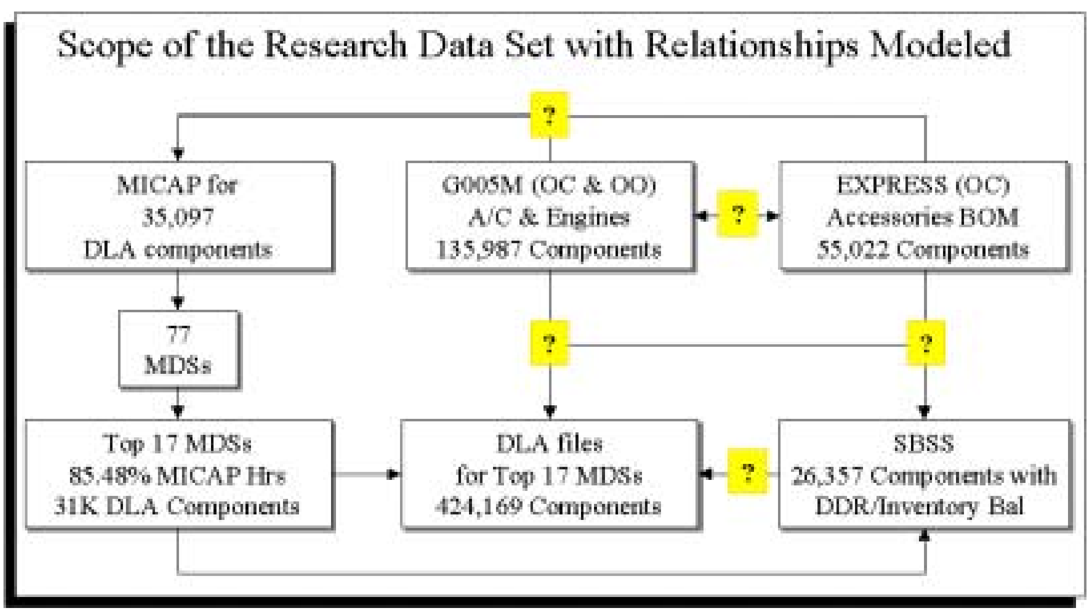

Figure 14. Scope of the Research Data Set with Relationships Modeled

With the extremely large scope and more than representative samples of data, there are still limitations. The next section discusses the limitations of this research.

Limits of the Research

Primarily due to limited time and computer laptop constraints, the only organizations analyzed in this research are AF depots, AF bases, and DLA. However, since DLA is the primary provider of consumable items to the DoD, the possible affects a DLA item has on AF weapon system availability and production support may also exist in other services. For example, an AF aircraft panel and an Army tank may require the same bolt provided by DLA. However, this research does not assess the potential impacts to other services and as such, may be understating the potential impact of an item relative to the DoD's total potential weapon system availability.

Attempting to Recreate a "Point in Time"

The data used for this research does not represent the exact same day across all of the systems that provided data. Though the timing may be very close, great caution should be exercised in drawing conclusions without understanding every nuance of system processing and how even a single day's difference may affect the overall appearance of system support. Table 14 lists the systems and the date that the data was extracted.

Table 14. Creating a Point in Time…Dates of the Data

System	Data Source/Table	Date of Data
DLA	Weapon System Records, Weapon System Codes	12/4/01
MICAP	dbo_MICAP	12/7/01
EXPRESS	dbo_BOM, dbo_Indenture, dbo_spt_results	12/6/01
G005M	G005M_04_records, G005M_09_records, G005M_23_records	12/7/01
SBSS	AFLMA Oracle Database	12/31/01

Limitations of an ACSC Laptop…Paring Down the MICAP Data

Given the initial volume of data and the limited Random Access Memory (RAM) of the laptop used for this research, MS Access query functions were not able to run to their completion. Consequently, it became necessary to reduce the size of the MICAP data set, the primary link between the database tables. Figure 15 reveals that reducing the record set in the MICAP table did not alter the percentage of AF MICAP hours attributed to DLA parts. Rather, it eliminated stock numbers that would not have had a MICAP since May 01, and retained only those items that had MICAPs for DLA-managed items during the period of May 01 through Nov 01.

Data Set Used For the Analysis

SOS	Percent of Oct 00 - Nov 01 MICAP Totals	Percent May 01 - Nov 01 MICAP Totals
DLA	48.74%	48.70%
OC	36.72%	36.84%
OO	4.45%	4.34%
SA	0.95%	0.19%
SM	0.02%	0.00%
Unk	0.68%	1.12%
WR	8.43%	8.81%

Figure 15. Reducing the MICAP Data Set From Oct 00 – Nov 01 to May 01 – Nov 01

However, reducing the data set did alter the ordinal rank of a weapon system. For example, the C-5 had the third highest total MICAP hours between been Oct 00 – Nov 01, but had the second highest total MICAP hours between May 01 – Nov 01. In total, reducing the MICAP data set had the following effects:

1. Reduced MICAP records/stock numbers by half
2. Eliminated stock numbers that had not had a MICAP since May 01

3. Reduced variances attributed to BRAC data transfers and cataloguing
4. Did not alter candidate population of critical weapon systems

Any further limitations, warrants, or data confounds will be referenced to and annotated in Appendix B, Warrants and Limitations.

This chapter discussed the research design and the limitations of the research. Relational modeling techniques and archival analysis were used to analyze the relationships between five data domains and over 2.7 million records. Chapter 4 examines each of the research objectives and documents the findings of each objective.

Chapter 3. End Notes

1. Prague, Cary N. and Amo, William C. and Foxall, James D., Access 97 Secrets, Copyright 1997, IDG Books Worldwide, Inc, pgs. 37-41

Chapter 4

IV. Results of the Study

Introduction

The archival analysis process and relational database techniques used for this research facilitated attaining the research objectives. This chapter documents the findings of the research objectives. Due to the volume of data used in the research, summary tables document the majority of the findings. However, individual examples of data points are included to provide clarification of the summary tables.

Objective 1. Identifying DLA Items That Cause the Most MICAP Hours

Identifying DLA managed items that caused weapon system MICAP hours during a previous month or period of time reveals the following information:

1. It provides a gauge for measuring the impact of not having an item or,
2. If historical data is available, it is possible to determine if the item is a new or recurring problem or,
3. It reports what items have caused MICAP hours.

By highlighting the items that caused the most MICAP hours in the past month, managers can use this information as a starting point for improving weapon system availability. Additionally, when coupling the item's price with the MICAP hours caused by an item, managers can assess if the price of the item is consistent with the level of weapon system degradation caused by the item.

Objective: Automate the identification of DLA items that contribute to the preponderance of weapon system non-availability.
Finding: Using archival analysis and relational database techniques, it is possible to create an automated list of DLA managed items that cause the most MICAP hours for the prior month. SMART contains a summary table (dbo_MICAP) that lists the total MICAP hours each NIIN has caused each month for each weapon system that the NIIN has impacted. Furthermore, this summary table also lists the applicable Source of Supply (SOS) for each NIIN. Archival analysis techniques can generate lists of the total MICAP hours by NIIN and by SOS. Figure 16 contains the SQL programming statement that was used to generate a list of DLA managed items from the dbo_MICAP table and the total MICAP hours each NIIN accumulated by month.

Stratifying MICAP Hours…Using SQL Programming

```
SELECT dbo_MICAP.DateDataPulled, dbo_MICAP.MonthNYear,
    dbo_MICAP.NIIN, dbo_MICAP.SOS, Sum(dbo_MICAP.Hours) AS
    SumOfHours, Sum(dbo_MICAP.TotalIncidents) AS SumOfTotalIncidents
FROM dbo_MICAP
GROUP BY dbo_MICAP.DateDataPulled, dbo_MICAP.MonthNYear,
    dbo_MICAP.NIIN, dbo_MICAP.SOS
HAVING (((dbo_MICAP.SOS)="DLA"))
ORDER BY dbo_MICAP.DateDataPulled DESC , Sum(dbo_MICAP.Hours) DESC;
```

Figure 16. Stratifying MICAP Hours…Using SQL Programming

This query was edited to retrieve the most current month of data, a specific month of data, or a range of months of data. Furthermore, lists were summarized by month, by item and by MDS. As an example, Table 15 lists the 10 weapon systems that garnered the most MICAP hours that were caused by DLA items for a specific month. Examples of the stock numbers that caused the most MICAP hours for a given month or a range of months are displayed in tables 16 and 17 respectively. In total, the research demonstrates that lists of DLA managed items can be generated through the SMART dbo_MICAP table and that these lists can be prioritized in virtually any sequence.

Table 15. Top 10 Weapon Systems That Accumulated the Most MICAP Hours For DLA Managed Items During Nov '01

Date Data Pulled	Month 'N Year	SOS	MDS	Sum Of Hours	Sum Of Total Incidents
12/7/01	Nov 01	DLA	F016	361,716	2070
12/7/01	Nov 01	DLA	C130	273,397	1808
12/7/01	Nov 01	DLA	J85-5	239,619	430
12/7/01	Nov 01	DLA	C005	238,403	854
12/7/01	Nov 01	DLA	F100-220	206,117	751
12/7/01	Nov 01	DLA	F015	197,287	1217
12/7/01	Nov 01	DLA	C135	169,341	1264
12/7/01	Nov 01	DLA	F101-102	157,562	427
12/7/01	Nov 01	DLA	TF34-100	145,210	398
12/7/01	Nov 01	DLA	F100-100	105,887	422

Table 16. May '01 – Nov '01…MICAP Hours of the Top Five DLA-Managed NIINs

NIIN	SOS	Sum Of Hours	Sum Of Total Incidents
013125928	DLA	228,559	519
013290707	DLA	199,598	336
003323861	DLA	165,161	251
013588927	DLA	163,957	282
012153477	DLA	154,496	505

Table 17. Nov '01…MICAP Hours of the Top Five DLA-Managed NIINs

Date Data Pulled	Month N' Year	NIIN	SOS	Sum Of Hours	Sum Of Total Incidents
12/7/01	Nov 01	003323861	DLA	30,130	45
12/7/01	Nov 01	009914181	DLA	28,961	46
12/7/01	Nov 01	013125928	DLA	28,807	102
12/7/01	Nov 01	003521836	DLA	26,646	49
12/7/01	Nov 01	011649031	DLA	25,382	46

As the rationale for this objective suggested, the unit price of the item may be associated with the MICAP hours caused by each NIIN. Using relational database techniques to associate the DLA unit price of an item with the MICAP hours for each NIIN, Table 18 depicts the aggregation of unit price vs. MICAP hours. Using the information in Table 18, senior managers can assess if the total MICAP hours caused by items within a unit price range is commensurate with the price of the items. Managers can also compute the yearly average number of aircraft within a price range that are Not Mission Capable Supply (NMSC) (i.e. cannot perform a mission due to the lack of a critical supply part). This can be computed by dividing the total MICAP hours within a price range by the total number of hours in a year.

$$\#AircraftNMCS\_ForOneYear_{\Pr iceRange} = \frac{\#MICAP\_Hours_{\Pr iceRange}}{24_{Hrs/Day}\, x365_{Days/Year}}$$

Referring to Table 18 and using items whose unit price is less than one dollar, dividing 731,288 MICAP hours by the number of hours in a year (8,760) yields 83.71 aircraft that are NMCS for an entire year—each for an item whose unit price is less than one dollar.

Table 18. May '01 - Nov '01…Total MICAP Hours For DLA-Managed Items Aggregated by Unit Price

Unit Price Range	Number of NIINs	MICAP Hours	Incidents	Sum Of UP x Incidents	Computed # AC/WS NMCS 1 Year
<=$1	3,069	731,288	6,840	$3,147.07	83.71
>$1 and <=$5	4,112	1,882,512	10,754	$28,102.79	215.49
>$5 and <= $10	2,084	924,284	5,308	$38,890.29	105.80
>$10 and <=$20	2,281	1,167,137	6,199	$91,214.81	133.60
>$20 and <=$50	3,399	1,672,506	8,973	$287,369.91	191.45
>$50 and <=$100	2,629	1,929,097	8,124	$589,957.20	220.82
>$100 and <=$300	3,967	3,825,531	14,618	$2,702,003.97	437.90
>$300 and <=$600	2,481	2,506,566	10,049	$4,369,483.63	286.92
>$600 and <=$1K	1,586	1,576,191	6,909	$5,435,093.82	180.42
>$1K and <=$2.5K	2,114	3,386,022	11,795	$19,012,289.43	387.59
>$2.5K and <=$5K	932	1,487,788	5,292	$19,053,551.78	170.31
>$5K and <=$25K	759	1,536,433	4,311	$39,954,188.85	175.87
>$25K and <=$1.5M	42	96,266	228	$10,762,023.88	11.02
Unit Price is Null or Zero	17	6,052	38	$0.00	0.69

Table 19 shows how MICAP NIINs related to a DLA Unit Price were summed to compute an average unit price per MICAP hour or incident. Table 20 shows the same data stratified by weapon system, and Figure 17 shows the data trended for a single weapon system—in this example, the F-16.

Table 19. Average Unit Price Per MICAP Hour/Incident from May '01 – Nov '01 For DLA Managed Items

Sum of (Number of Incidents x DLA UP)	Total Incidents	Total MICAP Hours	NIIN had a DLA Record	Avg UP Per Hour	Avg UP Per Incident
$102,316,687.51	99,438	22,727,673	Yes	$4.50	$1,028.95
	13,494	3,117,195	No		

Table 20. Top Five MICAP Hour Weapon Systems from May '01 – Nov '01 … Average Unit Price (UP) Per MICAP Hour For DLA Managed Items

MDS	Total Incidents	Total MICAP Hours	Sum Of (DLA UP x # Incidents)	Avg UP Per Hour	Avg UP Per Incident
F016	14,756	2,651,079	$18,383,442.03	$6.93	$1,245.83
C005	6,717	2,025,460	$20,041,870.13	$9.89	$2,983.75
C130	13,378	1,975,497	$10,485,569.39	$5.31	$783.79
F015	9,705	1,622,014	$12,128,709.31	$7.48	$1249.73
F100-220	5,545	1,553,501	$1,647,415.02	$1.06	$297.10

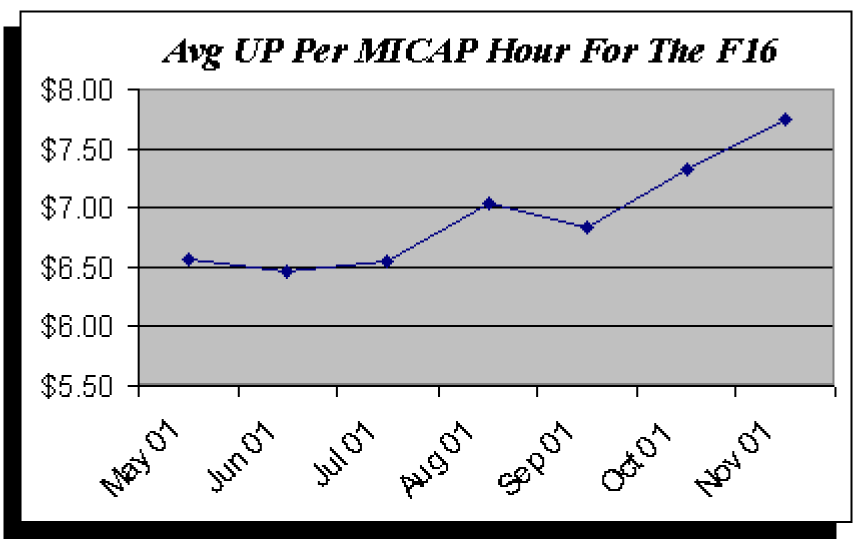

Figure 17. Average Unit Price Per MICAP Hour for the F-16

In total, the research demonstrates that an automated list can be generated and that managers can derive information that allows them to assess the impact of an item relative to its unit price. This information may be displayed by weapon system, NIIN or unit price. Last, managers are provided with new information to assess supply performance.

Objective 2. Identifying MICAP Items That Also Affect Depot Processes

By determining if an item affects base level weapon system availability rates and depot production processes, managers can assess if the sum of the impacts is commensurate with the cost of the item. The first research finding demonstrated that weapon system, month, or NIIN—or any combination of these data elements—could be used to prioritize DLA-managed items that caused base level MICAPs. Could archival analysis and relational database techniques also identify items that concurrently affect depot production processes?

> **Objective:** Automate the identification of wholesale production processes (i.e., aircraft production, engines, or accessories) that would be impacted by the non-availability of parts that were also contributing to weapon system non-availability.
> **Finding:** Using relational database techniques, a list of MICAP items could be related to lists of items in depot support processes. Using the NIIN as the relational field, DLA-managed items that caused MICAP hours can be related to lists of items that support depot weapon system overhaul processes and accessory repair processes. Figure 18 illustrates the principle of a single item causing base level MICAP hours, and is concurrently used to support depot production processes.

As Figure 18 illustrates, NIIN 01-220-3380 caused 22,865 MICAP hours between the months of May 01 and Nov 01. However, the AF G005M system lists four depot repair operations that require this NIIN as part of aircraft or engine overhaul processes. Furthermore, the depot induction system (EXPRESS) lists three End Item Identities (EIIDs, otherwise referred to as “end-items”) that require this NIIN—these same items may be MICAP at a base. As Figure 18 demonstrates, a single item may affect base level readiness and concurrently affect depot aircraft, engine and accessory production.

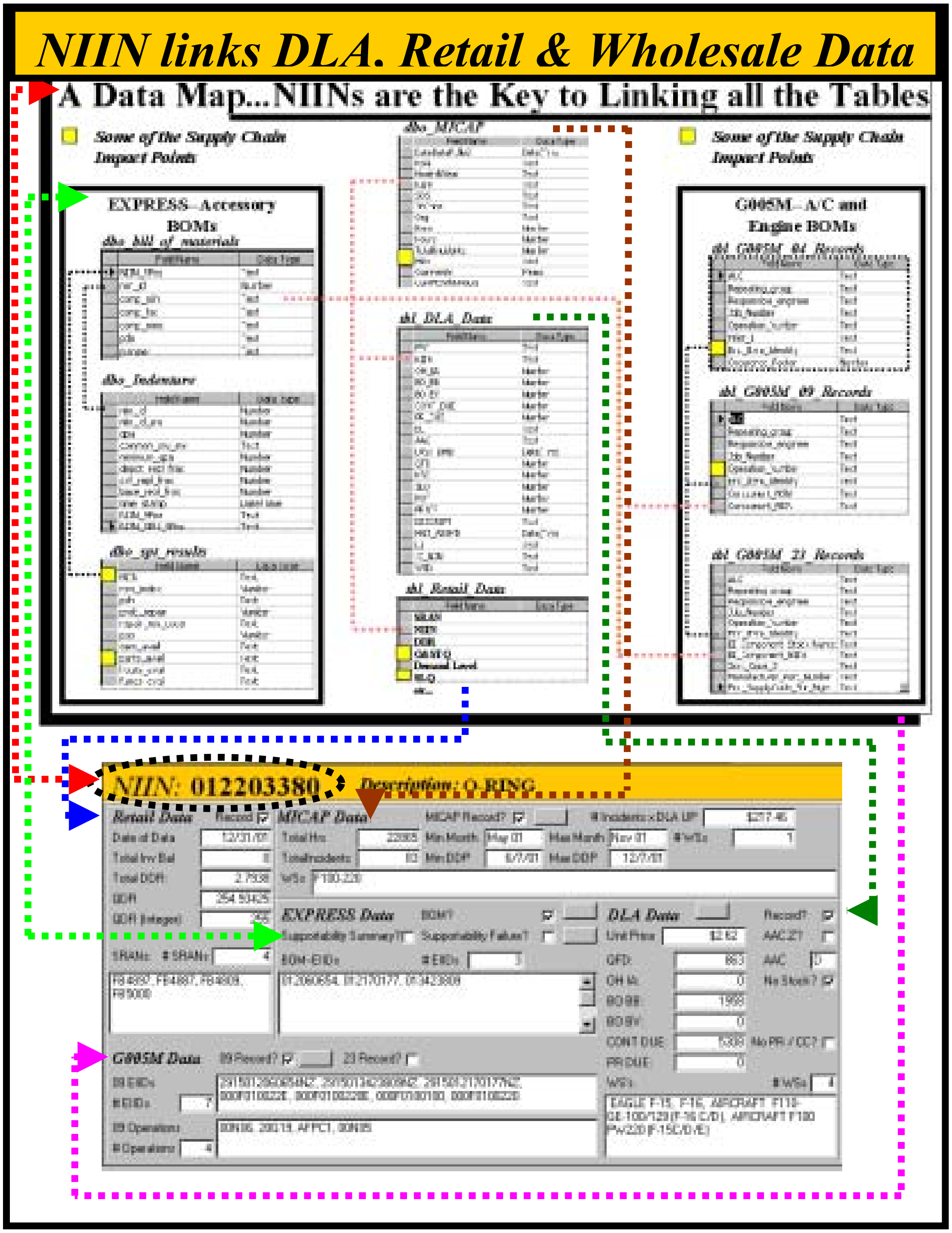

Figure 18. NIIN Links DLA, Retail and Wholesale Data

Tables 21 and 22 list the number of MICAP NIINs that were also found in the OC-ALC EXPRESS BOM and the OC-ALC or OO-ALC G005M files.

Table 21. Number of NIINs in EXPRESS BOM That Match the MICAP NIINs

Bit n' Piece is in OC EXPRESS BOM	Number of NIINs	Total MICAP Hours of these Items	Total MICAP Incidents of These Items
Yes	3,627	2,549,580	13,204
No	31,470	23,295,288	99,728

Table 22. Number of NIINs in G005M That Match the MICAP NIINs

Bit 'n Piece Has a G005M-09 Record	Number of NIINs	Total MICAP Hours of These Items	Total MICAP Incidents of These Items
Yes	11,263	8,264,156	42,343
No	23,834	17,580,712	70,589

These two tables quantify the number of items that caused MICAP hours at AF bases for a specified period of time that were also required for depot level production processes. Table 23 shows the total overlap between these three data domains as items may be in the MICAP list, EXPRESS BOM and the depot G005M database.

Table 23. MICAP NIINs That Are in OC-ALC or OO-ALC G005M and Are Also in the OC-ALC EXPRESS BOM

Bit 'n Piece Has a G005M-09 Record	Bit n' Piece is in OC EXPRESS BOM	#G005M Operations Impacted by NIINs	#EXPRESS BOM End Items Impacted by NIINs	Number of NIINs	Total MICAP Hours of These Items	Total MICAP Incidents of These Items
Yes	Yes	17,443	12,626	3,616	2,529,511	13,157
Yes	No	16,766		7,647	5,734,645	29,186
No	Yes		26	11	20,069	47
No	No			23,823	17,560,643	70,542

Conclusively, these tables demonstrate that lists of MICAP NIINs can be linked to depot operations that require the same items. By doing so, managers may begin to assess the potential system-wide impacts of not having a bit n' piece.

Objective 3. Identifying Conditions Likely to Impact Future Processes

Research finding #2 demonstrated items that cause AF base-level MICAP hours can also be used in AF depot production processes. Taken one step further, managers can use relational database techniques to link MICAP, G005M, EXPRESS, DLA, and SBSS data.

Objective: Automate the identification of conditions that are likely to generate MICAPs or have adverse impacts to support and production processes.
Rationale: Managers can assess the affects of inventory policies and determine if they are commensurate with the level of degradation they potentially cause.

In the course of this research, there were two findings for this objective. First, DLA administrative and procurement policies may not afford optimal support to a significant portion of the consumable items used by the AF. Archival analysis of the DLA data table revealed there are several thousand items without stock on hand for which the AF has recurring demands. Second, the AAC (coupled with DLA stockage policy) that is applied to an item may be a causal factor of AF MICAP hours.

Items With No Purchase Request (PR), No Contract…Inventory Balance of Zero?

Tables 24, 25, and 26 identify items used in depot processes for which DLA records show there is no on-hand stock, no PR for stock and no contract for stock. Without stock, depots and bases alike are unable to perform repair tasks that support AF readiness.

Table 24. Impact to End Items in EXPRESS That Use DLA-Managed Bits 'n Pieces

Item has a DLA Record	DLA stock balance is zero	Item is in the EXPRESS BOM, linked to an EIID	EXPRESS EIID failed for Bit n' Pieces?	Number of Items with all of these conditions	Total MICAP Hours	Total MICAP Incidents
Yes	Yes	Yes	Yes	5	4,490	21
Yes	Yes	Yes	No	320	805,513	2,318
Yes	Yes	No	No	4,964	10,172,280	27,205
Yes	No	Yes	Yes	148	32,674	394
Yes	No	Yes	No	3,044	1,647,407	10,210
Yes	No	No	No	20,991	10,065,309	59,290
No	No	Yes	Yes	3	6,197	20
No	No	Yes	No	107	53,299	241
No	No	No	No	5,515	3,057,699	13,233

Table 25. EXPRESS NIINs With No DLA Stock, No DLA PR, No DLA Contract

# EXPRESS Component NIINs	# of Operations Impacted by these NIINs	Item Has a DLA Record	DLA Record Shows No PR, No Contract	DLA Record Shows No Stock On-Hand
1,153	2,556	Yes	Yes	Yes
3,185	9,629	Yes	No	Yes
33,771	128,467	Yes	No	No
16,913	33,729	No	No	No

Table 26. G005M NIINs With No DLA Stock, No DLA PR, No DLA Contract

# G005M Bit 'n Piece NIINs	# of Operations Impacted by these NIINs	Item Has a DLA Record	DLA Record Shows No PR, No Contract	DLA Record Shows No Stock On-Hand
2,082	5,249	Yes	Yes	Yes
8,375	26,128	Yes	No	Yes
75,801	314,266	Yes	No	No
49,729	113,077	No	No	No

Table 27 stratifies the items with a DLA zero-balance on-hand inventory position against weapon system MICAP hours. In short, DLA asset balances fused with MICAP data allow managers to quantify the impact of DLA stockouts on AF readiness.

Table 27. The Five Weapon Systems That Had the Most NIINs With Zero Stock Balances…The MICAP Hours For Those NIINs From May '01 – Nov '01

MDS	Number of NIINs	DLA Record Has Zero (0) On-Hand Stock Balance	MICAP Hours	Total Incidents
F016	2,186	Yes	1,385,817	4,645
C005	1,715	Yes	1,244,943	2,815
J85-5	234	Yes	989,875	1,678
C130	1,886	Yes	783,613	2,946
F101-102	297	Yes	756,019	1,417

MICAP Hours by Acquisition Advice Codes

Table 28 stratifies the MICAP hours against AACs. As the literature review noted, AACs "J" and "Z" were of particular interest in a 1997 AFMLA study. These items are either purposely not stocked or have been designated as critical to the operation of a weapon system. Figure 19 stratifies the MICAP hours of AAC "Z" by weapon system.

Table 28. MICAP Hours by Acquisition Advice Code (AAC)

AAC	AAC Description	Total MICAP Hours	Total MICAP Incidents
D	DoD integrated materiel managed, stocked, and issued	18,986,574	85,746
F	Fabricate or assemble	4,440	29
H	Direct delivery under central contract	124,400	723
J	Not stocked—long lead time	288,336	700
V	Terminal item—stock available	56,437	224
W	Restricted requisitions--special instructions apply	3,285	33
X	Semi-active	663	2
Y	Terminal item--no stock	175,596	402
Z	Insurance/numeric stockage objective item	3,086,448	11,571

As depicted in Figure 19, the MICAP hours of a given AAC may be depicted by weapon system. In the example in Figure 19, the weapon system most affected by DLA managed items with an AAC of "Z" is the C-5, with over 24% of the total AAC "Z" hours belonging to the C-5. Furthermore, six weapon systems and an engine account for 79% of the total AAC "Z" hours. Managers may want to know if there is something peculiar to these weapon systems that result in them accumulating the majority of these MICAP hours. This decomposition process demonstrates that additional information regarding the causes of MICAP hours may be found in the AAC, and if desired, all of the MICAP hours for a given weapon system could be depicted by AAC.

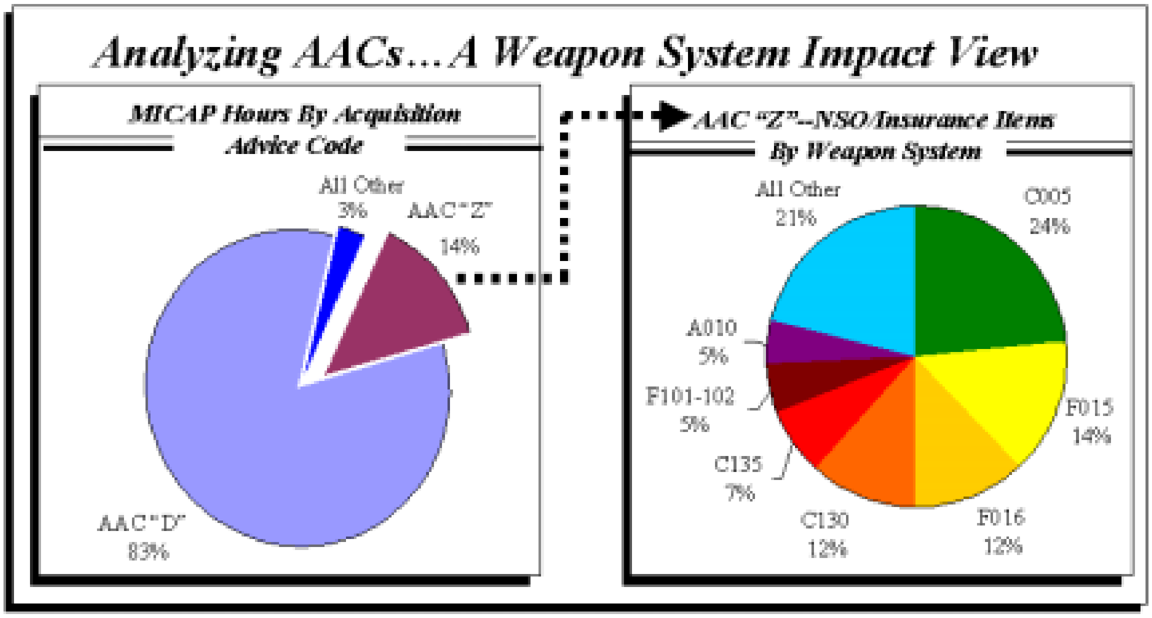

Figure 19. Analyzing AACs…A Weapon System Impact View

As demonstrated in Table 29, stratifying stockout data (discussed in the prior section) by AAC provides possible insights into DLA stock fund performance as deferred sales accumulate while waiting for stock to be procured and issued. Using just the AAC "D" and "Z" rows, we see the DLA quarterly sales forecast for these AACs is $667 million. However, the sum of the forecasts for AACs "D" and "Z" items with no stock is $166M. Therefore, potentially 25% of the sales for these items have been, or will be, deferred. Consequently, deferred sales affect DLA's ability to purchase materiel for stock, and in turn, their ability to satisfy AF retail and depot requests. In total, this process increases the likelihood of future AF MICAP incidents and impacts to depots.

Table 29. DLA Quarterly Sales Forecast Stratified by AAC and Stockage Position

DLA AAC	Quarterly Forecast Dollars	No Stock	No Stock No PR, No Contract
D	$498,049,364.36	$117,883,742.98	$18,981,741.52
F	$3,692.80	$271.64	$271.64
H	$6,351,494.52	$4,367,223.51	$2,682,339.99
I	$146.40	$0.00	$0.00
J	$20,052,259.39	$18,765,258.11	$15,647,343.39
K	$4,516.50	$120.17	$85.45
L	$337,184.70	$335,828.83	$19,165.90
P	$44,835.28	$39,231.95	$37,587.71
R	$765.50	$3.25	$3.25
T	$40.74	$0.00	$0.00
V	$6,750,726.85	$585,872.34	$565,009.72
W	$34,219.11	$3,395.44	$2,592.14
X	$21,500.67	$15,538.56	$13,832.43
Y	$2,121,159.81	$2,101,898.90	$1,963,417.97
Z	$169,329,722.70	$48,770,842.17	$27,057,046.30
Totals	**$703,101,629.33**	**$192,869,227.85**	**$66,970,437.41**

Summary

Each of the research findings was conclusive. Automated processes can identify MICAP NIINs that cause the most weapon system degradation. Relational database techniques can link data between depot production systems, DLA requirements and asset balance data, the AF SBSS and the MICAP system. Drawing on the relationships between these systems, managers can assess the impact of inventory stockage policies and determine if the level of degradation caused by an item is commensurate with its cost. Last, the AAC provides a means to relate MICAP hours to stockage and procurement policy and allows managers to assess the impact of those policies in terms of weapon system degradation. The next chapter contains the recommendations for addressing the findings of this research.

Chapter 5

V. Conclusions, Management Implications, Recommendations

Overview

This chapter presents the conclusions, management implications, and recommendations for each of the research objectives.

Objective 1. Identifying DLA Items That Cause the Most MICAP Hours

Using archival analysis, this objective was successfully completed. SQL programming was used to create prioritized lists from the SMART dbo_MICAP table. Furthermore, MICAP NIINs were related to DLA unit prices and facilitated the aggregation of MICAP hours by ranges of unit prices.

Conclusions

Table 19 noted the average UP per AF MICAP hour was $4.50 for DLA managed items. Table 18 showed the equivalent of 83.71 aircraft were grounded for an entire year for items whose unit price was less than one dollar. As reflected in Table 30, relating MICAP data to DLA cost data allows managers to correlate cost to impact and to determine if the level of degradation is commensurate with the cost of an item.

Table 30. Relating Unit Price to MICAP Hours

Unit Price Range	*# Incidents*	*# NIINs*	*# MICAP Hours*	*% Total Hours (A)*	*Running Sum (A)*	*% Total NIINs (B)*	*Running Sum (B)*
<=$1	6,840	3,069	731,288	3.22%	3.22%	10.41%	10.41%
>$1 and <=$5	10,754	4,112	1,882,512	8.28%	11.50%	13.95%	24.37%
>$5 and <= $10	5,308	2,084	924,284	4.07%	15.57%	7.07%	31.44%
>$10 and <=$20	6,199	2,281	1,167,137	5.14%	20.70%	7.74%	39.18%
>$20 and <=$50	8,973	3,399	1,672,506	7.36%	28.06%	11.53%	50.71%
>$50 and <=$100	8,124	2,629	1,929,097	8.49%	36.55%	8.92%	59.63%
>$100 and <=$300	14,618	3,967	3,825,531	16.83%	53.38%	13.46%	73.09%
>$300 and <=$600	10,049	2,481	2,506,566	11.03%	64.41%	8.42%	81.51%
>$600 and <=$1K	6,909	1,586	1,576,191	6.94%	71.35%	5.38%	86.89%
>$1K and <=$2.5K	11,795	2,114	3,386,022	14.90%	86.24%	7.17%	94.06%
>$2.5K and <=$5K	5,292	932	1,487,788	6.55%	92.79%	3.16%	97.22%
>$5K and <=$25K	4,311	759	1,536,433	6.76%	99.55%	2.58%	99.80%
>$25K and <=$1.5M	228	42	96,266	0.42%	99.97%	0.14%	99.94%
Unit Price is Null or Zero	38	17	6,052	0.03%	100.00%	0.06%	100.00%

Management Implications of the Research

Automating the identification of DLA items that contribute to the preponderance of weapon system non-availability provides a starting point for improving weapon system availability. Using data portrayed in Table 30 allows managers to gauge the impacts of an investment strategy and focus investment where it is likely to have the greatest impact on weapon system availability. As reflected in Table 30, investing in the relatively nominal dollar values of DLA items can significantly increase AF readiness for minimal costs.

Recommendations

AFMC, DLA, the AF Depots and the AF Supply community should adopt a standardized methodology of identifying DLA managed items that cause MICAP hours.

AFMC, DLA, the AF Depots and the AF Supply community should develop metrics that correlate the cost of an item with its level of degradation and indicate overall trends.

Objective 2. Identifying MICAP Items That Also Affect Depot Processes

Again, using relational database techniques and archival analysis, this objective was successfully completed. Using the NIIN to relate data between the DLA, EXPRESS, G005M, MICAP, and AF SBSS data sets, the analysis was able to demonstrate the linkage of MICAP NIINs to data in other tables or systems.

Conclusions

This research successfully employed relational database techniques to integrate and assimilate DLA, EXPRESS, G005M, MICAP, and AF SBSS data sets. Doing so facilitated the automated identification of depot processes that use the same items that are MICAP at AF bases. Table 17 revealed that approximately 10% of the DLA items that caused MICAPs between May ’01 and Nov ’01 are also used in OC-ALC accessory repair processes. More significantly, Table 18 revealed that approximately 32% of the MICAP NIINs are used in OC-ALC and OO-ALC aircraft and engine production processes. Consequently, when DLA cannot satisfy AF retail requests for stock, it is likely that DLA cannot satisfy AF depot requests for stock. As reflected in Table 20, accessories are not produced when bits ‘n pieces are not available. Aircraft or engine production schedules are lengthened to accommodate the wait time for a DLA managed bit ‘n piece. In either case, not having an inexpensive bit n’ piece at the right time reduces AF readiness, degrades depot production processes and increases overhead costs. Building on finding #1, a system view of data provides new insights.

Management Implications of the Research

Automating the identification of MICAP NIINs that may also be affecting depot support processes allows managers to assess the system-wide impacts of not having a DLA managed bit ‘n piece. Figure 20 depicts the possible impacts to system support costs when a DLA bit n’ piece is not in the right place, at the right time, in the right quantity. In short, total system support costs exceed their optimum when bits n’ pieces are not available, thus placing a greater premium on their availability.

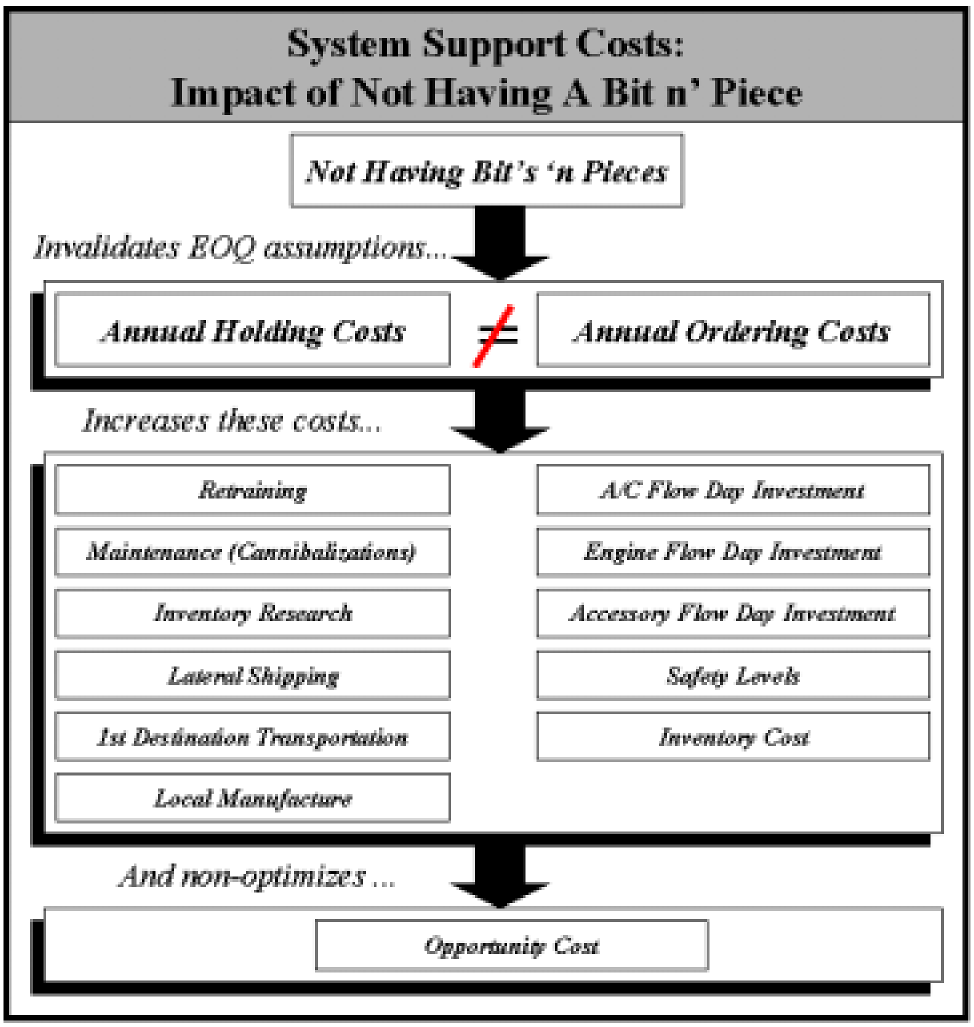

Figure 20. System Support Costs…Impact of Not Having a Bit n’ Piece

Recommendations

Building on recommendation #1, AFMC, DLA, the AF Depots and the AF Supply community should develop a means to integrate the data sources used for this research. Using Oracle Developer, MS Access, or other 4^{th} generation programming tools, minimal resources can develop and continue to explore the integration of these data sources (i.e. a single individual accomplished this research in less than 4-5 months). Most importantly, corporate managers in the DoD should identify and quantify the impact to system support processes of not having DLA managed items. Using this information, a business case analysis can compare the value of increasing DLA responsiveness as measured against the increased costs depicted in Figure 20 when a DLA bit n' piece is not available. In doing so, AF readiness and depot production can be improved by shifting the increased costs depicted in Figure 20 to increasing DLA responsiveness (i.e., increasing inventories, velocity management, software enhancements accommodating stochastic demand patterns, etc). In total, system support costs can remain constant while increasing AF production and readiness.

Objective 3. Identifying Conditions Likely to Impact Future Processes

Again, using relational database techniques and archival analysis, this objective was successfully completed. Using the NIIN to relate data between the DLA, EXPRESS, G005M and MICAP data sets, the analysis was able to identify DLA NIINs without stock on hand. Tables 20, 21, 22, 23 and 25 stratified items without stock on hand by weapon system, AAC, forecasted sales, and EXPRESS/depot production processes. In addition, AACs were linked to MICAP hours and stock balances, which in turn facilitated stratifying MICAP hours by AAC and AACs by stock balances.

Conclusions

Items without stock on hand, that have no PR or contract in place to obtain new materiel, will likely cause MICAP hours and increase depot flow days for aircraft, engine and accessory production. As an example, Table 22 showed that 31,377 of the 345,643 (12%) operations in OC-ALC and OO-ALC require bits n' pieces for which DLA had no stock on hand. Table 25 depicted that $166 million of anticipated DLA quarterly sales were for items AAC "D" and "Z" items that had no stock on hand. As Table 31 indicates, approximately 43% of the MICAP NIINs showed a zero inventory balance in DLA's system. In these examples, AF production operations are degraded when DLA cannot provide a bit 'n piece and DLA stock fund performance degrades as deferred sales accumulate while waiting for inventory from their suppliers.

Table 31. MICAP NIINs…How Many Showed No Stock in DLA's Inventory?

# MICAP Records	*Had a matching record in the DLA data set?*	*DLA Record showed No Stock On-Hand (OH IA)?*	*DLA Record showed No PR, no Contract?*	*Total MICAP Hours*	*Total MICAP Incidents*
707	Yes	Yes	Yes	609,036	1,820
4,582	Yes	Yes	No	10,373,247	27,724
754	Yes	No	Yes	270,781	2,147
23,429	Yes	No	No	11,474,609	67,747
5,625	No	No	No	3,117,195	13,494

Management Implications of the Research

As highlighted in the literature review, inventory de-couples materiel operations (i.e. production processes) from supply procurement and distribution lead-times. When inventory is not available, significant costs are incurred across the system support process as attempts are made to mitigate the lack of a bit n' piece. Degraded DLA stock fund performance further constrains their ability to support DoD requirements.

Recommendations

Building on recommendations #1 and #2, AFMC, DLA, the AF Depots and the AF Supply community should develop a means to automate the identification of conditions that are likely to impact future support processes. Items without stock and no PR or contract are but one possible situation. Other conditions may include, but are not limited to, the following:

1. DLA items with on-hand balances below the reorder point and no contract or PR
2. Items with AF (or DoD) consumption rates exceeding the support provided by DLA safety levels
3. Incorrect AAC assignment
4. Invalid assumptions of AF and DLA requirements models which may inherently foster MICAP conditions
5. Unit Price biases in requirements algorithms that preclude purchasing adequate stocks to mitigate variability in demand and vendor deliveries during replenishment lead-time
6. Data transmission fidelity

Mitigating stockouts has the benefit of reducing MICAP hours, increasing stock fund performance (both DLA and the AF) and reducing total system support costs.

Further Research Opportunities

The scope of this research is tremendous. Over 2.7 million records from three major systems and at least 10 system tables represent a significant corpus of data. Many more related issues could add tremendous value in improving DoD weapon system availability. Also, the relatively short amount of time allotted to complete this research does not permit investigating all of the potential issues identified from this effort. Other aspects of this research that should be investigated include, but are not limited to, the following:

1. Simulating and quantifying the impact to AF spares pipelines as a function of DLA supply availability.
2. Simulating and quantifying the impact to AF aircraft flow days as a function of DLA supply availability.
3. Simulating and quantifying the impact to AF accessories production as a function of DLA supply availability.
4. Simulating and quantifying the impact to AF stock fund performance as a function of DLA supply availability.
5. Create a system view of all DoD services (AF, Army, Navy, Marines, and Coast Guard) that mirrors the approach taken in this research. This would facilitate quantifying the impact to all services when a DLA bit n' piece is not available.
6. Consider developing consumable bench stocks at the depots that are treated like war readiness materiel—they are only used as a last resort, i.e. when retail supply cannot provide the bit n' piece off the shelf. This would buffer the effects of DLA non-supportability and have the likely effect of reducing aircraft and engine flow days and pipeline spare requirements.
7. Simulating and quantifying the impact to AF readiness as a function of DLA supply availability. This would facilitate establishing a DLA supply availability metric with some intended, quantifiable, relationship to AF readiness goals.

Summary

This research project incorporated 2.7 million records from 5 different sources, and reviewed the impact of over 400,000 DLA managed items that are projected to generate $700 million in sales per quarter--$2.8 billion for the year. In total, this research project reviewed the 17 AF systems that accumulated the most MICAP hours between Oct 00 and Nov 01. The research found that items that cause MICAPs are also failing production in EXPRESS and are needed in AF aircraft and engine overhaul processes. Using the NIIN to relate data from one table to another, managers can assess if the level of degradation caused by an item is commensurate with its cost. Last, the automation of the identification of likely problems, sources of problems and degraded processes significantly shortens the cycle time required to identify a problem and then work the solution. The AF and DLA needs a system view of the impacts a single bit n' piece can have on supportability and readiness. With such a view, it becomes more possible to mitigate the instance of a $1 part grounding an aircraft, crippling a production line and delaying the completion of overhauling an aircraft. In summary, every weapon system and organization in the DoD can benefit from the automation processes highlighted in this research. Army, Navy, Air Force, Marines and Coast Guard—they can all increase mission capability through the optimization of DLA support. Lastly, information can be leveraged to optimize supportability and that increases readiness—for the AF and DoD.

Appendix A

Appendix A. Other Finding(s)

Chapters 4 and 5 addressed the findings of the research objectives. This appendix contains other findings that were not listed in the research objectives.

EOQ Assumption That Demand Is Known, Constant, and Continuous

Using relational database techniques to compare the DDR of the SBSS data from the 30 Sep 01 file to the 31 Dec 01 file, the research shows there is significant volatility in AF retail demands. In general, variances between the two data sets can be characterized in the following manner:

1. Usage of a NIIN may increase
2. Usage of a NIIN may decrease
3. Usage of a NIIN may not change at all (demand is constant, and is either greater than zero or equal to zero)
4. New requirements may emerge for NIINs that have never been requested before
5. NIINs that are removed from the inventory (i.e., as a result of obsolescence) will no longer be included in the requirement computation

Table 30 represents the comparison of usage data for NIINs as of 9/31/01 and 12/31/01. By comparing the usage of a NIIN in each point in time, it is possible to determine if usage of an item is constant. In doing so, it is possible to determine if a key assumption of the EOQ model, demand is constant, is valid. Table 30 depicts the aggregated results of comparing the usage data for NIINs in both the 9/31/01 and 12/31/01 SBSS data sets.

Table 32. SBSS Requirements…Not Constant, Not Continuous

Delta Dollars	***#NIINs Meeting this Condition***	***Characterization of Volatility***
$5,760,417.06	Computed requirement greater than zero in the 12/31/01 SBSS data set, and computed a requirement greater than zero in the 9/30/01 SBSS data set--12/31/01 SBSS data set computes a larger requirement than the 9/30/01 SBSS data set	Dec 01 > Sep 01 (Increasing Requirements)
$1,409,804.48	Computed zero requirement in 9/30/01 SBSS data set, and computed a requirement greater than zero in the 12/31/01 SBSS data set	Dec 01 > Sep 01 (Increasing Requirements)
$0.00	Computed zero requirement in 9/30/01 SBSS data set, and computed zero requirement in the 12/31/01 SBSS data set	Dec 01 = Sep 01 (Zero variance in the requirement)
$0.00	Computed requirement greater than zero in the 12/31/01 SBSS data set, and computed a requirement greater than zero in the 9/30/01 SBSS data set	Dec 01 = Sep 01 (Zero variance in the requirement)
($964,782.75)	Computed zero requirement in 12/31/01 SBSS data set, and computed a requirement greater than zero in the 9/30/01 SBSS data set	Dec 01 < Sep 01 (Decreasing Requirements)
($6,072,431.71)	Computed requirement greater than zero in the 12/31/01 SBSS data set, and computed a requirement greater than zero in the 9/30/01 SBSS data set --9/30/01 SBSS data set computes a larger requirement than the 12/31/01 SBSS data set	Dec 01 < Sep 01 (Decreasing Requirements)

Figure 21 depicts that there is a net shift in requirements of over $14 million dollars for these 23,000 MICAP NIINs that are forecasted to generate $85 million for DLA during a quarter—a 16% shift in just 3 months time. Furthermore, approximately 70% of the stock numbers are decreasing/increasing their requirements, or may be new, seasonal, or terminal requirements.

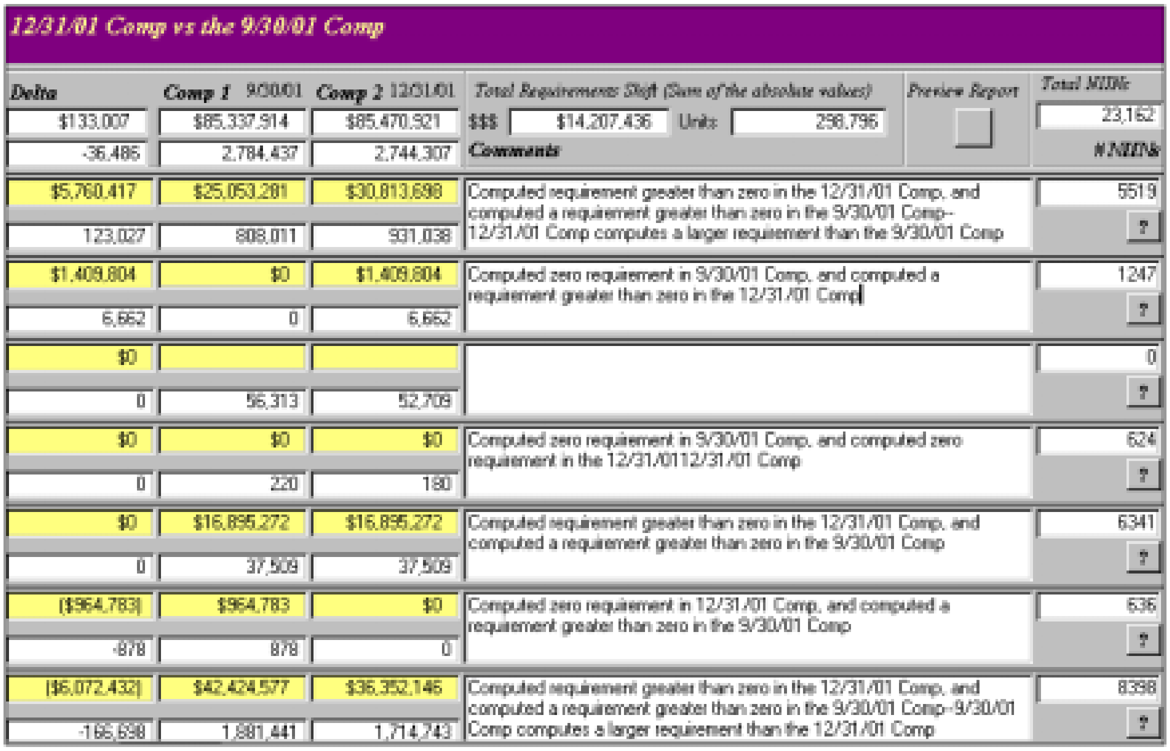

Figure 21. AF SBSS Shifting Requirements…Demand is Constant and Continuous?

In total, Figure 21 indicates there are significant changes in retail requirements. Furthermore, AF retail requirements change significantly in as little as 90 days, thus violating the first assumption of the AF EOQ model.

Management Implications of the Research

AACs "J" and "Z" represent a significant portion of the projected DLA sales. AAC "J" items are non-stocked, long lead-time items with projected quarterly sales of $18 million for the weapon systems included in this research. If DLA has not already placed an order for an AAC "J" item at the time a retail request is submitted, then a weapon system will likely be incapacitated during the entire lead-time of the item. As for the AAC "Z" items, these items are "insurance". They are normally critical to the operation of a weapon system and though they may be low demand items, they can have tremendous negative affects to readiness when they are not stocked. However, stocking these items represents risk to the DLA stock fund as they are less likely to generate sales.

Of the 26,000 MICAP NIINs that had matching records in the DLA record set, 70% of the NIINs had usage rates that decreased or increased from 30 Sep 01 to 31 Dec 01. Aggregating these variances represents a potential shift in the DLA sales mix of 16%. Without knowing the frequency of DLA's releveling/requirements generation process, it is not possible to speculate how DLA accommodates this variance. However, this finding suggests that the first assumption of the EOQ may not be valid—even if only for a subset of stock numbers. Consequently, stock numbers whose demand patterns violate the principle of "constant and known" demand may not be adequately supported by their computed safety levels, thus potentially leading to MICAP requisitions.

Recommendations

AFMC, DLA and the AF Depots should collaboratively reassess AAC "Z" and "J" items and determine if there are more appropriate AACs for those items. Also, items that are MICAP should be reviewed to determine if they may be more adequately classified as AAC "Z" and submitted for catalogue changes if applicable.

AFMC, DLA, the AF Depots and the AFLMA should seek an alternative method of computing the DDR component of the EOQ for items whose demand patterns are not "known and constant". Stochastic methods of computing DDR are available in commercial software products and are likely to perform more optimally than the deterministic methodology of the SBSS EOQ. In short, incorporating a stochastic methodology for computing the AF SBSS DDR exchanges software programming dollars for recouped hours in AF readiness.

Appendix B

Appendix B. Research Warrants and Limitations

Warrant for Data Fidelity

It is not possible to validate the fidelity of the data. At best, data used in the research can be matched to the original data sent or retrieved from the applicable organization. However, if an originating system contains erroneous data, it is likely that other automated processes are reacting to the erroneous data. If so, interfacing systems may potentially be drawing erroneous conclusions (just as the research process might if the data is corrupt or flawed). As a precaution, a series of edits were performed for each of the data sources used in this research. The edits did not reveal any significant anomalies in the data sets. Appendix D lists the results of each edit that was preformed.

Warrants for AF MICAP Hour Totals From Oct 00 – Nov 01

Sacramento ALC and San Antonio ALC have been allocated MICAP hours during this timeframe. Given these depots were closed as a result of congressionally mandated BRAC actions, the hours allocated to these depots should have been allocated to the sources of supply that assumed management responsibilities for the applicable items. However, tens of thousands of stock numbers transferred management responsibilities during the BRAC process. As such, some transfer items were not updated in the cataloguing system at the time a MICAP was submitted.

Also note there is an "unknown" category. An item may generate a MICAP requisition before it has been catalogued; therefore, it cannot be allocated a source of supply. Conversely, an item may be removed from the catalogue because of disposition and disposal actions and will subsequently generate a MICAP requisition. In either case, there will not be a Source of Supply to allocate the item to. Alternatively, erroneous data may also result in an item's allocation to the "unknown" source of supply category.

Lastly, within D165B, the MICAP totals for each month may change slightly at virtually any point in time as data is constantly being adjusted, deleted, or appended. Though computed totals may vary slightly at any point in time, any change would likely not statistically alter the results of these charts or DLA's position as the foremost cause of AF MICAP hours.

Warrant for Cause of MICAPs

AF or base-level policy may warrant the exclusion of maintaining stocks of a particular item. For example, a base may choose not to stock an item that is hazardous, thus mitigating the amount of effort and physical resources required to maintain inventory. However, if the item is critical to the weapon system, then the base recognizes that when the item is needed, a MICAP requisition will have to be placed to expedite the receipt of the item. The AF MICAP Cause Code reveals the reason that an item was ordered MICAP. However, the record sets used in this research did not contain the MICAP Cause Codes. As such, though it is likely the preponderance of the MICAP hours are attributable to DLA policies and non-supportability, it is not possible to distinguish the amount of MICAP hours that were incurred as a result of retail policies. For a list of MICAP Cause Codes, refer to Appendix D. MICAP Policies & Procedures.

Warrant for Interchangeable & Substitute Grouping(s) (I&SG)

The I&SG determines the extent that one item is interchangeable with another item. In an I&SG, there is a “most preferred item”, and a “least preferred item”—and there may be items in between these two categories. Inventory managers prefer to issue the “least preferred items” when possible, as this practice reduces inventory obsolescence costs (costs associated with maintaining and disposing of items that no longer have retail value due to their obsolescence).

In linking the database tables, NIINs were matched to exact NIINs. However, items in one table may be linked to items in another table through an I&SG relationship. The extent to which this phenomenon exists is unknown. However, all of the data that is presented in this research is the result of exact matches between tables using the NIIN as the key field. As such, results may tend to be understated, as items without exact NIIN matches from one table to another have been categorized as non-matched.

Warrant for Number of Units Per Incident

The data used in this research did not contain the number of units associated with each MICAP, but rather, the number of incidents associated with an aggregate number of MICAP hours for a given NIIN on a specific weapon system. Only by referencing the original requisition would it have been possible to determine the actual number of units ordered per incident. Consequently, financial relationships are expressed as unit price per incident rather than cost per incident.

Appendix C

Appendix C. Examples of Findings…Specific NIINs

This section contains examples of the findings from Chapter 4. For each example, an actual NIIN record is used to illustrate the finding.

NIIN that Caused the Most MICAP Hours from May '01 to Nov '01

As illustrated in Figure 22, NIIN 01-312-5928 (a clip-on nut that costs $158.15) caused the most AF MICAP hours between May '01 to Nov '01. The total MICAP hours during this period were 228,599, stemming from 519 incidents. Note that the AF has a quarterly demand rate of 373 items, or approximately 22% of the 1,722 units DLA projects selling in the quarterly forecast demand (QFD). Furthermore, note that 13 AF bases had a stock record for this item and that the combined total inventory of these bases was 16 units. Last, note that the DLA inventory position (OH IA) was zero (0) units and that they had incurred 2,398 backordered units. However, a contract (CONT DUE) for 12,948 units had been established (though the delivery date of those units is not known).

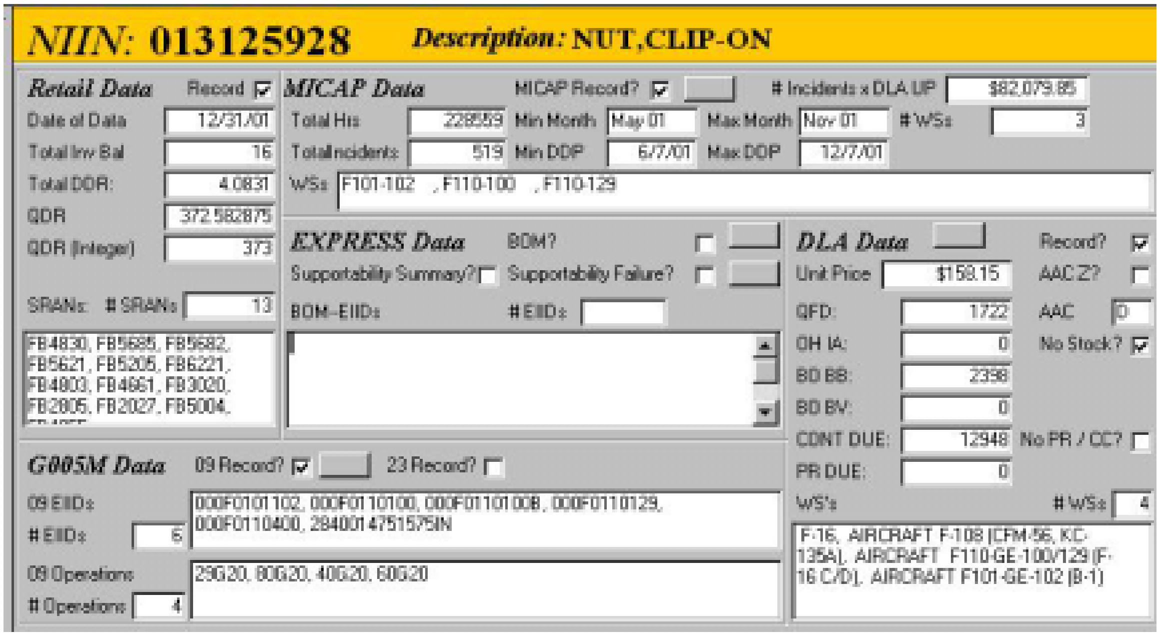

Figure 22. NIIN That Caused the Most MICAP Hours May ’01 to Nov ‘01

Cheapest NIIN That Caused MICAP Hours May ’01 – Nov ’01

As stated in Chapter 2, if the right number of bits n’ pieces are not in the right place at the right time, then regardless of their cost, their absence can degrade a weapon system’s capabilities. As depicted in Figure 23, NIIN 00-496-7171, a seal, contributed to 480 MICAP hours during May ’01 to Nov ’01. Furthermore, note the weapon systems affected by the MICAP incidents—B-1, C-17, C-130, C-135 and F-16. Also note the significant amount of inventory in the system at this time: DLA had over 263,000 units on hand (OH IA) and the AF retail accounts had over 16,000 units on hand (Tot Inv Bal). Conclusively, a one-penny part can have significant negative effects when not in the right place, at the right time and in the right quantity.

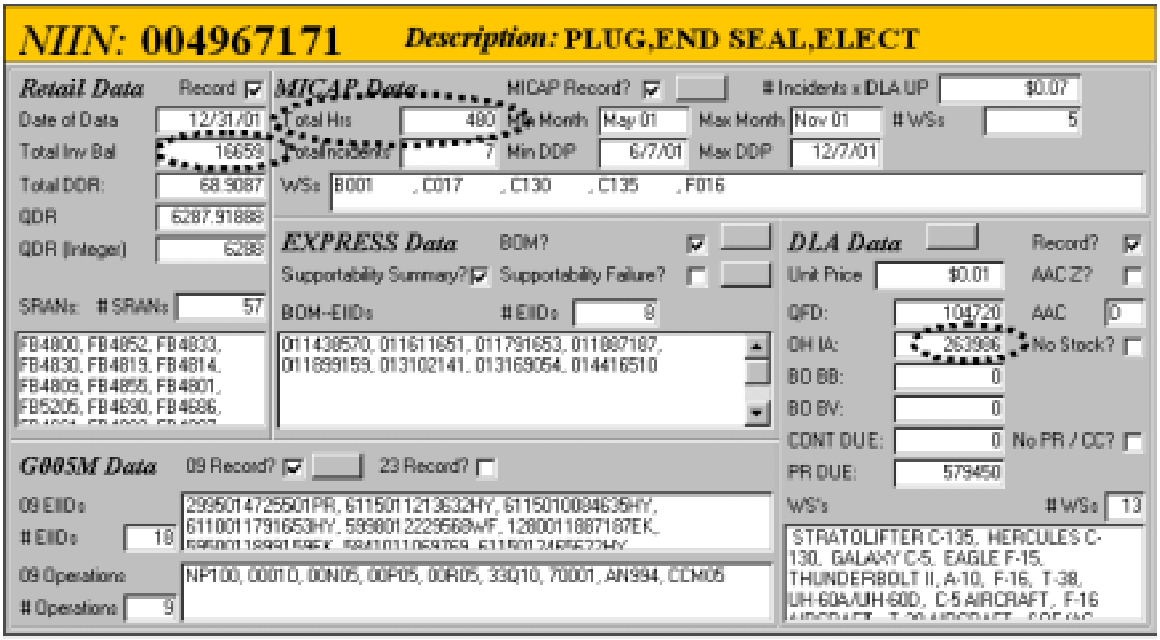

Figure 23. Cheapest NIIN that Caused MICAP Hours Between May '01 to Nov '01

Item Less Than One Dollar that Caused AF Base Level MICAPs and Is Used By AF Depots

As depicted in Figure 24, NIIN 00-382-7664 caused 7,819 MICAP hours between May '01 and Nov '01. More significant, note that the DLA on-hand (OH IA) inventory balance was zero in Nov '01 and that the AF retail accounts had approximately 11 (Total Inv Bal=393, divided by Total DDR=36.7) days of inventory remaining before they completely exhausted their stocks. Note the item's unit price is $0.32. Also, note the depot's dependence on this same item for aircraft, engine and accessory operations. In this example, DLA has established a Purchase Request and a Contract totaling 48,000 units of inventory. However, over 12,000 of those units will be immediately consumed by the backorders that exist, or the equivalent of two entire quarters, without being able to satisfy a customer demand (Total BB [12,116] divided by DLA QFD [5982]).

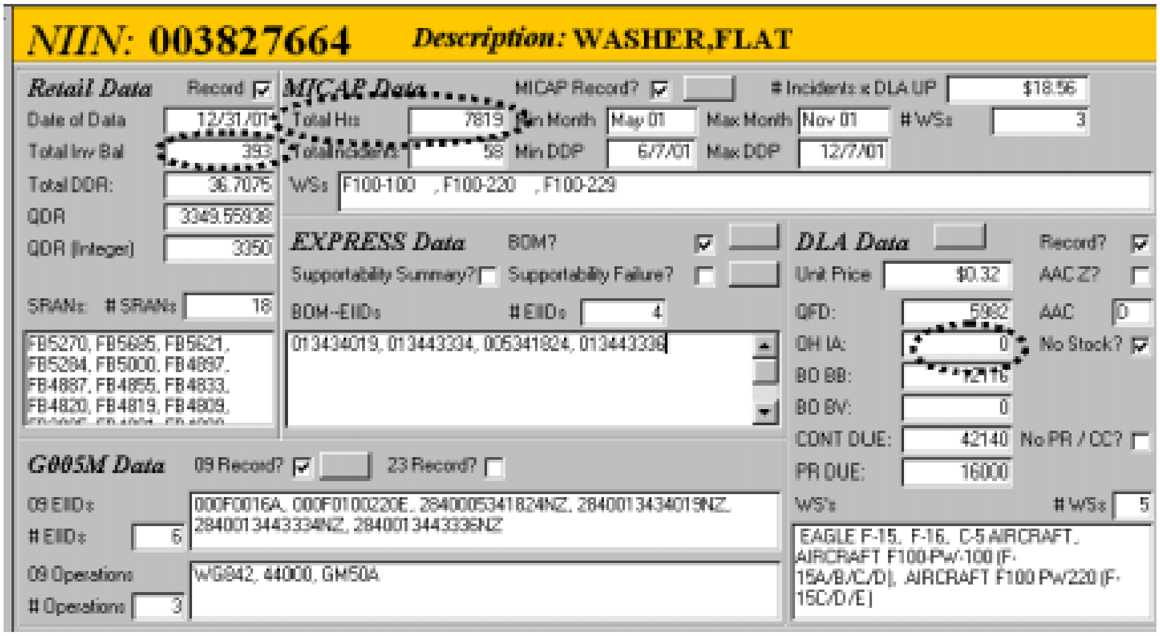

Figure 24. Item That Caused Base Level MICAPs and is Used In Depot Processes

NIIN in EXPRESS BOM that Matches MICAP NIIN—and Has End Items In EXPRESS that Have Parts Supportability Failures

As depicted in Figure 25, NIIN 00-902-6676 caused 1,686 MICAP hours between May ’01 and Nov ’01. Note that this item is used in the repair of items in EXPRESS. Since the Supportability Failure box is checked, at least one of the end items listed did not have sufficient bits ‘n pieces to be repaired. Note the AF has approximately three quarters of stock on hand (Total Inv Bal =274 divided by QDR=90, approximately 3 QDR). However, note that the DLA on-hand balance (OH IA) is zero. Without additional data, this analysis cannot conclusively deduce that an item in EXPRESS failed for a specific bit n’ piece. However, the data does reflect that DLA bits ‘n pieces are used in the repair of EXPRESS items and there are instances where DLA has no stock on hand. Using D035K asset balance data, it is possible to conclusively determine if a bit ‘n piece caused a supportability failure.

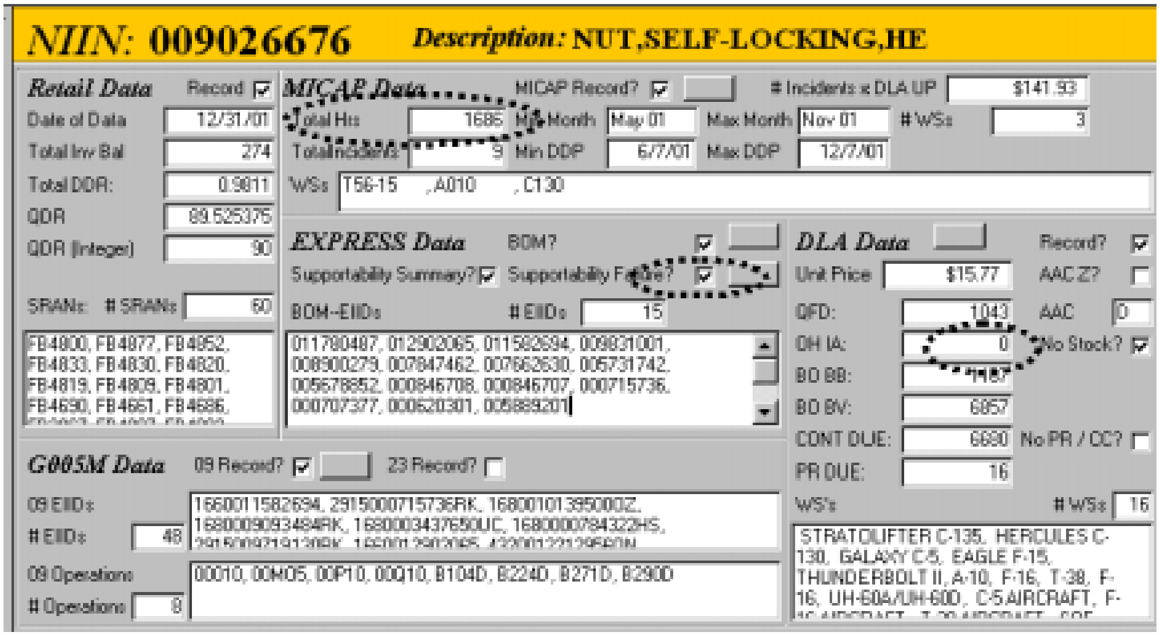

Figure 25. A Bit n' Piece that Caused AF Base MICAPs and is Used in EXPRESS

An Item That Is Likely to Impact Programmed Depot Maintenance

As Figure 26 depicts, NIIN 00-982-3692 caused 101,860 MICAP hours between May 01 and Nov 01. This NIIN has an aggregate quarterly consumption rate of 206 items per quarter by 14 AF retail locations and yet had reached an aggregate asset position of 2 serviceable units. Also note that while DLA indicated there were 2,246 backordered units of this item, DLA also reflected a positive inventory balance of 166 units. As such, units were being held in reserve while backorders accumulated. From the depot's perspective, note that this item is needed for 12 EIIDs and 3 operations. Given that all the AF base stock has been virtually depleted, it is likely that the depot is in a similar asset position. Last, note that while the DLA item is needed for aircraft and engine overhaul processes, it is also used in EXPRESS accessory production processes.

As such, while this item is causing MICAPs at AF bases, it is likely that AF depot production processes are also being affected by the non-availability of the same item.

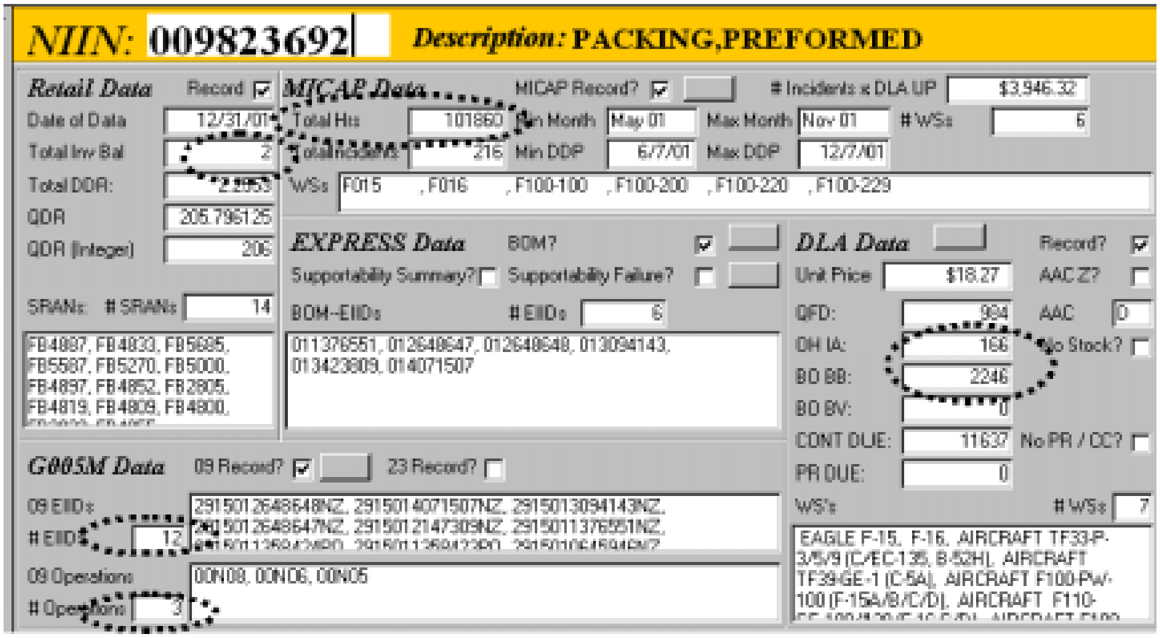

Figure 26. Example of a MICAP NIIN that Will Also Likely Impact Programmed Depot Maintenance

No Stock On-Hand, No PR, No Contract…No Backorders?

As Figure 27 depicts, NIIN 00-357-2574 caused 20,571 MICAP hours between May 01 and Nov 01. This NIIN has an aggregate quarterly consumption rate of 46 items per quarter by three AF retail locations, and had reached an aggregate asset position of 31 serviceable units. Note that the AF aggregate consumption level of 46 exceeds the DLA quarterly forecasted demand of 45 by a single unit. In particular, note that the DLA on-hand inventory (OH IA) is zero, there is no contract (CONT DUE) and there is no purchase request (PR DUE). Last, note that there are no backorders for this item, though the AAC "D" suggests it is still an active item. Why are there no backorders? For example, AF bases may have not reached their reorder points, the item may have "missing backorders" (i.e., requisitions lost in transmission) or the item may have a requisition exception code which suppresses automatic requisitioning of the item. Whatever the reason, at the point a backorder is placed, the requester will have to wait the duration of the administrative and procurement lead-times before DLA will have the item to fill the customer's request.

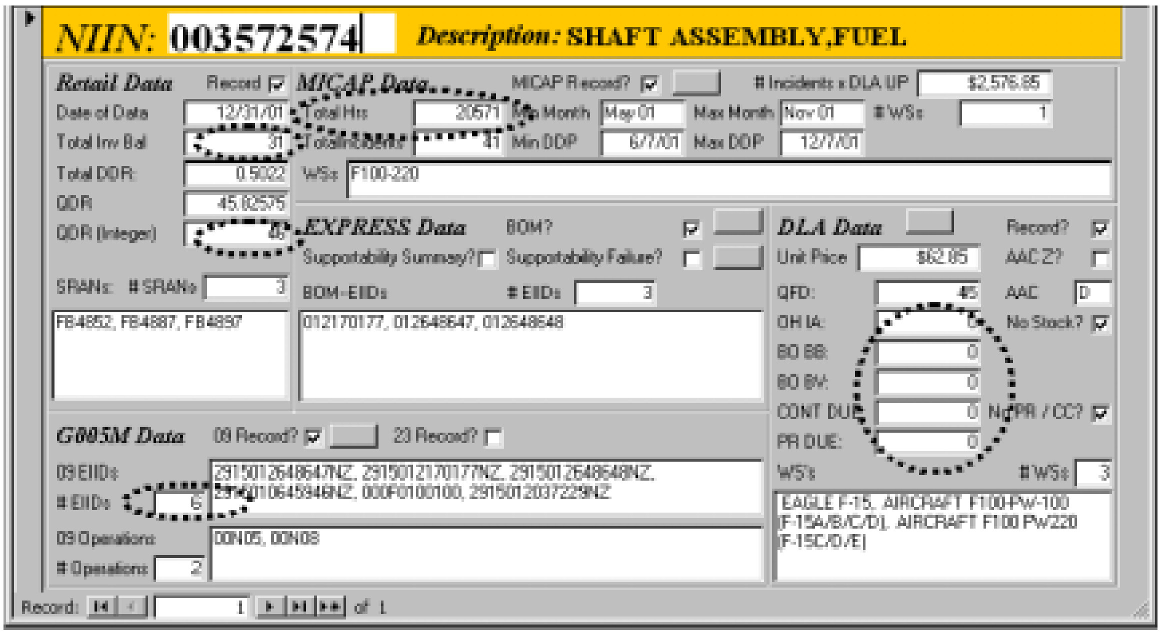

Figure 27. No Stock On-Hand, No PR, No Contract…No Backorders?

AAC "Z"…Nominal Usage, Critical Component…No DLA Stock

As Figure 28 depicts, between May 01 and Nov 01, NIIN 00-906-5479 caused 52,154 MICAP hours. This NIIN has an aggregate quarterly consumption rate of three items per quarter by six AF retail locations and had an aggregate asset position of three serviceable units. Note that though the demand level is nominal, the item can cause significant mission degradation when not available. Also note that DLA had reached a zero on-hand stock balance (OH IA), and had placed a contract (CONT DUE) for 81 units. Given the quarterly forecast demand QFD of 5, once the 13 backorders are satisfied from the receipt of the 81 items, there will be 68 units remaining. Even if 10 more units are requested before the shipment of 81 units is received, 58 units of stock would represent over 11 quarters of DLA forecasted demand (58 units divided by DLA QFD of 5 equals 11.6 quarters). In this example, there will be sufficient units for more than two years worth of demand. However, allowing the on-hand balance to reach zero has obvious mission impacts to the AF. As such, DLA stock replenishment orders need to be placed well in advance of the on-hand balance reaching zero units—at least sufficient enough to compensate for the administrative and procurement lead-times.

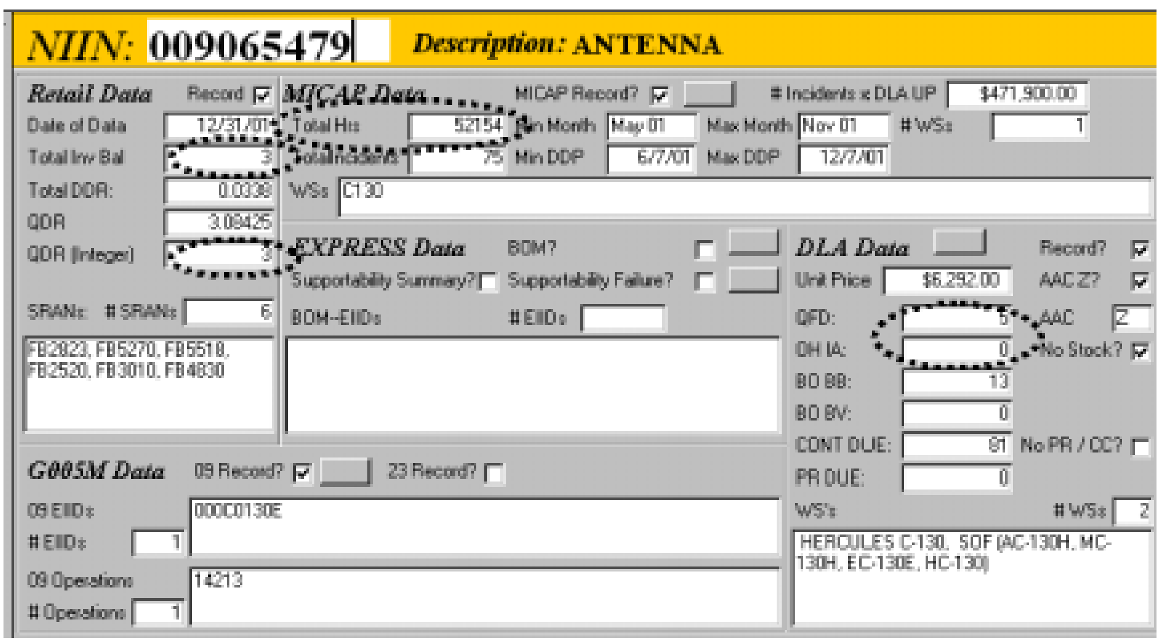

Figure 28. AAC "Z"…Nominal Usage, Critical Item…No DLA Stock

AAC “Z”…DLA QFD is 56,116…Nominal Usage?

As Figure 29 depicts, NIIN 00-844-4872 caused 586 MICAP hours between Jun 01 and Nov 01. This NIIN has an aggregate quarterly consumption rate of 5,620 items per quarter by 61 AF retail locations and had an aggregate asset position of 22,026 serviceable units. The DLA quarterly forecast (QFD) is 56,116 units, while the on-hand stock was 749,674. This item is extensively used in all phases of depot production operations. However, as the literature review of this research pointed out, AAC “Z” should be used for items that have “nominal” use—does 56,116 items per quarter qualify as “nominal” use? Most importantly, this example highlights the ability of archival analysis to identify conditions en masse that should be changed—or at least highlighted for review and considered for change.

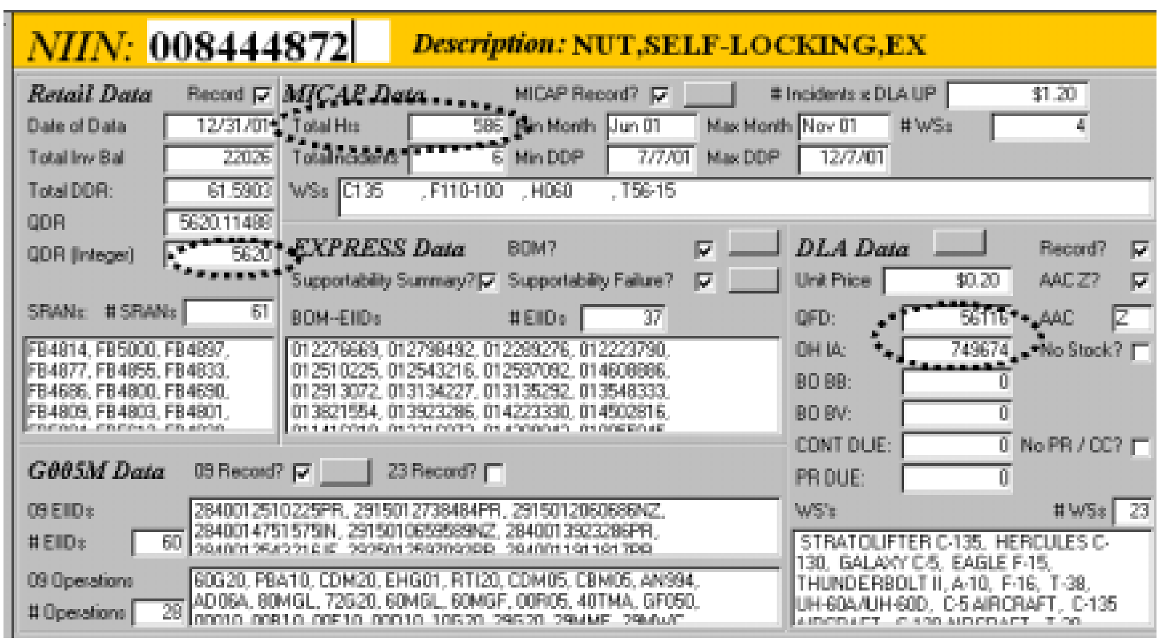

Figure 29. AAC “Z”…DLA QFD is 56,116…Nominal Usage?

AAC "Y"…"Terminal Item—No Stock"…DLA QFD is 429

As Figure 30 depicts, between May 01 and Nov 01, NIIN 01-017-7758 caused 112,605 MICAP hours. This NIIN has an aggregate quarterly consumption rate of 17 items per quarter by five AF retail locations and had an aggregate asset position of three serviceable units. The DLA quarterly forecast (QFD) is 429 units, while the on-hand stock was zero. DLA had placed a contract (CONT DUE) for 4,406 units to resolve the 1,378 backorders (BO BB) and satisfy future demands with the remaining stock. Like the prior example, this highlights the value of using automated processes to identify conditions that are likely to be incorrect. In this example, the data would suggest the item is not "terminal" (obsolete). If DLA policies suppress automatic requisitioning of terminal items, then this item would be affected and subsequently, so would AF production processes.

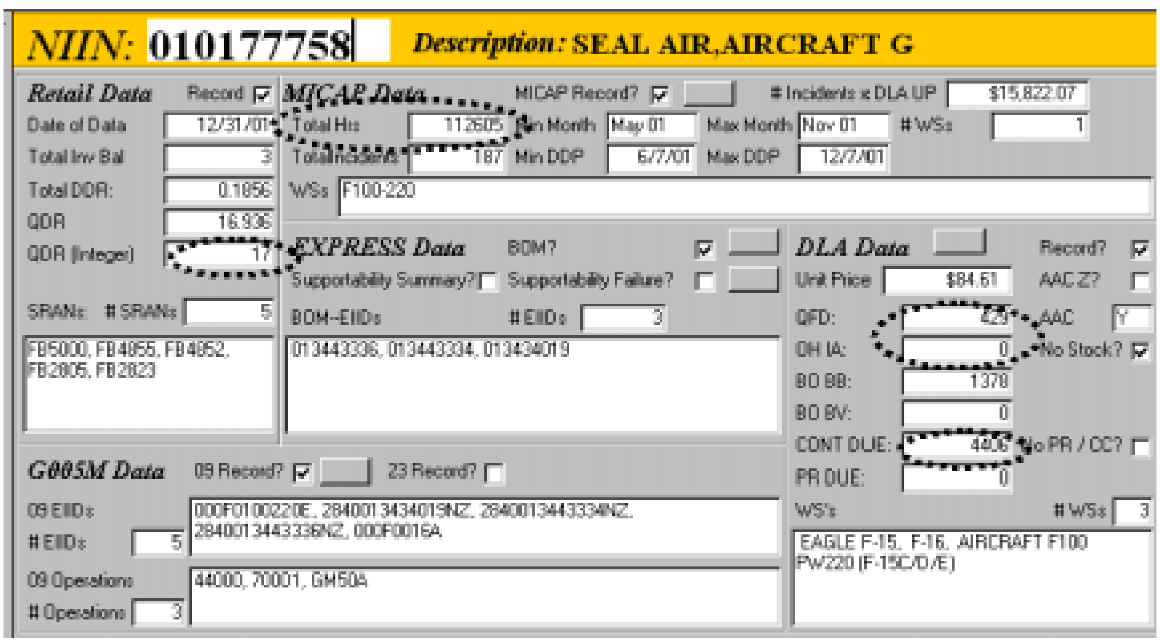

Figure 30. AAC "Y"…"Terminal Item—No Stock"…DLA QFD is 429

An Example of Delayed Sales…$50,466.20

As Figure 31 depicts, between May 01 and Nov 01, NIIN 01-104-8393 caused 423 MICAP hours. This NIIN has an aggregate quarterly consumption rate of 17,078 items per quarter by 16 AF retail locations and had an aggregate asset position of 4,709 serviceable units. DLA forecasted sales of 32,785 units and had a backlog of 36,033 backorders. By multiplying the item's unit price of $1.40 by the 36,033 backordered units, we see DLA has delayed or deferred sales of $50,466.20 for this single item. Given DLA's on-hand stock is zero, backorders will continue to accumulate until the contract or PR quantities are received. During that same time, delayed sales will also continue to accumulate. This example highlights Finding 3, which noted that as much as 25% of DLA's forecasted sales were for items which had no stock on hand.

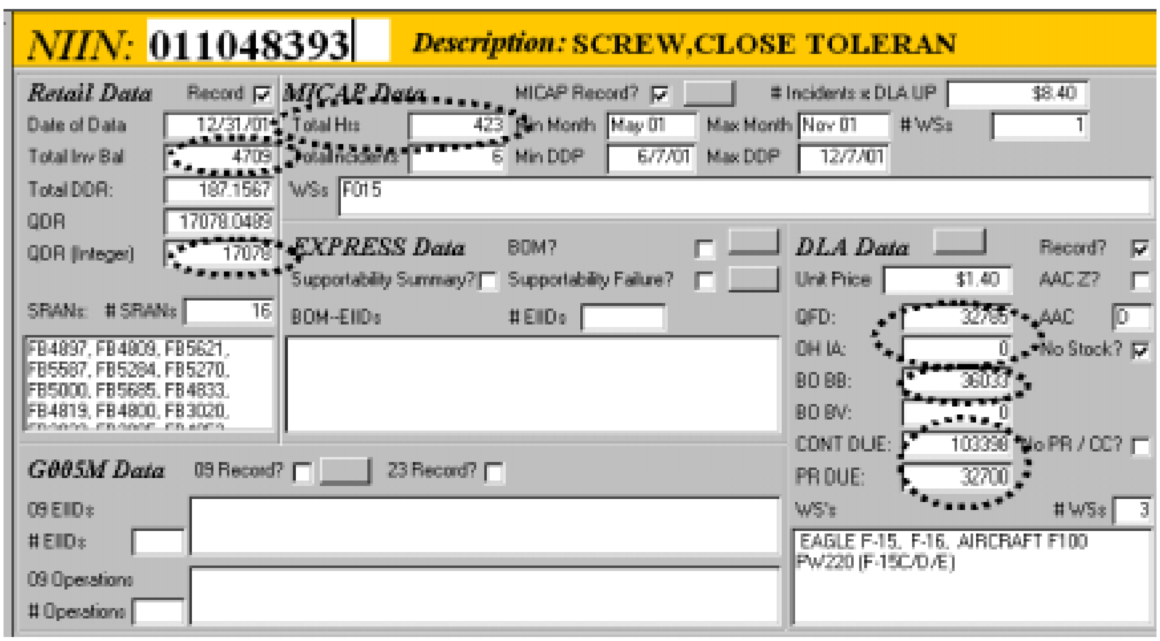

Figure 31. An Example of Delayed Sales…$50,466.20

Summary

This appendix of examples highlights the flexibility, robustness and value of using automated processes to identify conditions en masse that may affect supportability. As a starting point, using items that have caused MICAPs is useful in for two reasons: first, it identifies bits n' pieces the support process has failed and second, it allows us to relate those bits n' pieces to end items that will be impacted. Integrating the DLA, SBSS, G005M, MICAP and SBSS data provides a more comprehensive view of an item than could otherwise be gleaned from looking at any one system. This more comprehensive view underscores the degree of interdependence that exists between AF depots, AF bases and DLA. Optimizing warfighting capability becomes a function of optimizing the degree of supportability DLA and AF depots can provide to AF bases. These examples show that. Last, by looking forward and identifying conditions en masse that are likely to cause future non-supportability, corporate managers can begin to mitigate the impact to readiness of non-optimal support processes. In doing so, they will also increase the solvency of their stock funds as parts are more likely to be in the right place, at the right time, in the right quantity, for the right price.

Appendix D

Appendix D. Data

Possible Data Discrepancies—By Table

The data edits were designed to identify the number of records that were missing data. Missing data will tend to skew analysis, as it can result in the overstatement or understatement of impacts. As Table 31 below reflects, the Retail data table was the only table with a potentially significant amount of missing data—i.e. 17.7% of the records received were missing DDR data.

Table 33. Data Fidelity Edits For the Data Used in This Research

System	***Data Source/Table***	***Edit***	***Discrepancy Noted***
DLA	Weapon System Records	Null Price, NIIN, AAC, Quarterly Forecast Demands (QFD) fields	*954 Null Price fields (<00.1%) of all records, No null NIIN fields, 757 records with no AAC (<00.1%), No Null QFD fields*
DLA	Weapon System Codes	Weapon System Codes Used for more than one weapon system	*None*
MICAP	dbo_MICAP	Null values in the Weapon System, NIIN, MICAP Hours, MICAP Incident fields	*None*
EXPRESS	dbo_BOM	Null component NIIN or NIIN_ID fields	*None*
EXPRESS	dbo_Indenture	Null NIIN_ID or NIIN_ID_SRU fields	*None*

System	Data Source/Table	Edit	Discrepancy Noted
EXPRESS	dbo_spt_results	Null NIIN field	*None*
G005M	G005M_04_records	Null End Item Identity fields	*None*
G005M	G005M_09_records	Null Component NIIN or End Item Identity fields	*None*
G005M	G005M_23_records	Null End Item Component NIIN or End Item Identity fields	*None*
SBSS	AFLMA Oracle Database / SBSS Data	Null DDR	*39K of the 220K records had null DDRs (17.7%)*

DLA Data…The Weapon Systems used in this Research

Table 32 contains a list of the weapon system files provided by DLA. Included in the table are the number of records that were contained in each file, the weapon system, weapon system code, and category. These weapon system files were requested because these weapon systems accounted for approximately 84% of the total AF DLA MICAP hours during the period Oct 00 to Nov 01.

Table 34. Weapon System Files Provided By DLA

# Records	*Weapon System Category*	*Weapon System (WS) Nomenclature*	*WS Code*
984	SIMULATOR	A-10	55
4788	SUPPORT	A-10 AIRCRAFT	84
6664	ENGINE	AIRCRAFT F110-GE-100/129 (F-16 C/D)	BV
7241	ENGINE	AIRCRAFT F-108 (CFM-56, KC-135A)	BA
5341	ENGINE	AIRCRAFT F100 PW220 (F-15C/D/E)	DL
13432	ENGINE	AIRCRAFT F100-PW-100 (F-15A/B/C/D)	BT
5103	ENGINE	AIRCRAFT F101-GE-102 (B-1)	BX
752	ENGINE	AIRCRAFT GE T-700 (UH-60A)	BJ
3056	ENGINE	AIRCRAFT T56-A-7/15 (C-130B/E/H/N/P)	BH
14786	ENGINE	AIRCRAFT TF33-P-3/5/9 (C/EC-135, B-52H)	AY
14902	ENGINE	AIRCRAFT TF33-PW-102 (C-135E, EC-135H/K/P)	AX
2117	ENGINE	AIRCRAFT TF34-GE-100 (A-10)	BE
6791	ENGINE	AIRCRAFT TF39-GE-1 (C-5A)	BR
3625	ENGINE	AIRCRAFTJ85-GE-5/13 (F-5A/B, T-38A)	CB

# Records	Weapon System Category	Weapon System (WS) Nomenclature	WS Code
1036	SIMULATOR	C-130	52
7566	SUPPORT	C-130 AIRCRAFT	97
6562	SUPPORT	C-135 AIRCRAFT	96
22020	SUPPORT	C-5 AIRCRAFT	86
107541	AIRCRAFT	EAGLE F-15	19
2790	SIMULATOR	F-15	48
11175	SUPPORT	F-15 AIRCRAFT	82
89216	AIRCRAFT	F-16	26
3509	SIMULATOR	F-16	47
12946	SUPPORT	F-16 AIRCRAFT	92
69763	AIRCRAFT	GALAXY C-5	11
565	SUPPORT	H-60 HELICOPTER	91
73324	AIRCRAFT	HERCULES C-130	06
70880	AIRCRAFT	SOF (AC-130H, MC-130H, EC-130E, HC-130)	AT
71959	AIRCRAFT	STRATOLIFTER C-135	05
16993	AIRCRAFT	T-38	42
21023	SUPPORT	T-38 AIRCRAFT	98
28549	AIRCRAFT	THUNDERBOLT II, A-10	24
9842	HELICOPTER	UH-60A/UH-60D	75

Mission Design Series with Reported MICAPs for DLA Items between May 01 – Nov 01

The following Mission Design Series (MDSs) reported MICAPs in the D165B system between May 01 to Nov 01. As noted in Table 33, an MDS may be a weapon system, an engine, an accessory, etc.

Table 35. List of Mission Design Series in MICAP Table

Mission Design Series						
A010	C135	F100-229	GPN012	H001	T037	TF33-103
ASR009	C141	F101-102	GPN020	H053	T038	TF33-7
B001	E003	F108-100	GPN022	H060	T039	TF33-9
B002	E004	F110-100	GRC211	J69-25	T400-400	TF33-P5
B052	E008	F110-129	GRN030	J79-17	T56-15	TF34-100
C005	F004	F117	GRN031	J85-100	T56-7	TF39-1
C009	F015	F117-100	GRN032	J85-5	T64-100	TPN024
C017	F016	F118-100	GRT022	MPN014K	T700-700	TPN025
C018	F100-100	FPN062	GSC037	OJ314	T700-701	TPX042

Mission Design Series						
C048	F100-200	FRN044	GSH072	OK236	TF33-100	TRN026
C130	F100-220	FRN045	GSN012	T001	TF33-102	U002

Database Schema

This section contains the database schema—or layout for each of the tables used in the research. The data elements, type of data, and size (of the data element) are listed for each table. Where applicable, the indexes are listed. The indexes provide additional information regarding the edits that may have been developed for a table—i.e. what data elements were not allowed to have null values, and so forth. Also, the indexes reveal the "key" of a table—i.e. the field or combination of fields in a row of data that uniquely define that row as being different from all the other rows in the table. In total, the purpose of providing the database schema is to facilitate the recreation of the database design and to provide visibility of the data elements that were not included in the research. Given the time constraints of the research, there were many more avenues of exploration—some of which are highlighted in the concluding section of Chapter 5, Recommendations for Further Research. Last, the level of detail provided in this schema is intended for use by an experienced systems design engineer that is familiar with wholesale and retail supply system terminology.

Table: dbo_bill_of_materials

<u>*Columns*</u>

Data Element	**Type**	**Size**
NIIN_9Pos	Text	9
niin_id	Number (Long)	4
comp_niin	Text	9
comp_fsc	Text	4

comp_mmc	Text	2
pdn	Text	6
planner	Text	6
mgr_code	Text	2
bud_code	Text	1
unit_of_issue	Text	2
cust_code	Text	1
errc	Text	1
smc	Text	4
unit_cost	Number (Single)	4
occ_fac	Number (Long)	4
qpa	Number (Long)	4
std_rpl	Number (Long)	4
act_rpl	Number (Long)	4
curr_prod	Number (Long)	4
qtr1_prod	Number (Long)	4
qtr2_prod	Number (Long)	4
qtr3_prod	Number (Long)	4
qtr4_prod	Number (Long)	4
qtr5_prod	Number (Long)	4
qtr6_prod	Number (Long)	4
qtr7_prod	Number (Long)	4
curr_issue	Number (Long)	4
qtr1_issue	Number (Long)	4
qtr2_issue	Number (Long)	4
qtr3_issue	Number (Long)	4
qtr4_issue	Number (Long)	4
qtr5_issue	Number (Long)	4
qtr6_issue	Number (Long)	4
qtr7_issue	Number (Long)	4
time_stamp	Date/Time	8

Table Indexes

Name		**Number of Fields**
bud_code		1
	Clustered:	False
	Distinct Count:	16
	Foreign:	False
	Ignore Nulls:	False
	Name:	bud_code
	Primary:	False
	Required:	False
	Unique:	False
	Fields:	bud_code, Ascending
cust_code		1

	Clustered:	False
	Distinct Count:	10
	Foreign:	False
	Ignore Nulls:	False
	Name:	cust_code
	Primary:	False
	Required:	False
	Unique:	False
	Fields:	cust_code, Ascending
mgr_code		1
	Clustered:	False
	Distinct Count:	108
	Foreign:	False
	Ignore Nulls:	False
	Name:	mgr_code
	Primary:	False
	Required:	False
	Unique:	False
	Fields:	mgr_code, Ascending
niin_id		1
	Clustered:	False
	Distinct Count:	2037
	Foreign:	False
	Ignore Nulls:	False
	Name:	niin_id
	Primary:	False
	Required:	False
	Unique:	False
	Fields:	niin_id, Ascending

Table: dbo_indenture

Columns

Data Element	Type	Size
niin_id	Number (Long)	4
niin_id_sru	Number (Long)	4
qpa	Number (Integer)	2
common_sru_sw	Text	1
minimum_qpa	Number (Integer)	2
depot_repl_frac	Number (Byte)	1
cirf_repl_frac	Number (Byte)	1
base_repl_frac	Number (Byte)	1
time_stamp	Date/Time	8

NIIN_9Pos	Text	9
NIIN_SRU_9Pos	Text	9

Table Indexes

Name	Number of Fields
niin_id	1
Clustered:	False
Distinct Count:	3742
Foreign:	False
Ignore Nulls:	False
Name:	niin_id
Primary:	False
Required:	False
Unique:	False
Fields:	niin_id, Ascending

Table: dbo_MICAP

Columns

Data Element	**Type**	**Size**
DateDataPulled	Date/Time	8
NSN	Text	15
MonthNYear	Text	6
NIIN	Text	11
SOS	Text	3
IMCode	Text	6
Org	Text	10
Rank	Number (Long)	4
Hours	Number (Double)	8
TotalIncidents	Number (Double)	8
MDS	Text	12
Comments	Memo	-
CurrMonthNHours	Text	35
DLA_UP	Currency	8
DLA_Record_YesNo	Yes/No	1
DLA_AAC	Text	1

Table Indexes

Name	Number of Fields
IMCode	1
Clustered:	False
Distinct Count:	1

Foreign:	False
Ignore Nulls:	False
Name:	IMCode
Primary:	False
Required:	False
Unique:	False
Fields:	IMCode, Ascending

Table: dbo_spt_results

Columns

Data Element	**Type**	**Size**
NIIN	Text	9
row_index	Number (Long)	4
pdn	Text	6
prob_repair	Number (Single)	4
repair_res_code	Text	8
pap	Number (Single)	4
carc_avail	Text	1
parts_avail	Text	1
hours_avail	Text	1
funds_avail	Text	1
repair_cost	Number (Single)	4
repair_hours	Number (Single)	4
sort_value	Number (Double)	8
boa_seq	Text	2
boa_priority_code	Text	3
boa_document_date	Text	4
item_count	Number (Long)	4
buffer_hours_avail	Text	1
slimm_pap	Number (Single)	4
sos_alc	Text	2
sor_alc	Text	2
DateDataPulled	Date/Time	8

Table Indexes

Name	Number of Fields
boa_priority_code	1
Clustered:	False
Distinct Count:	1
Foreign:	False
Ignore Nulls:	False
Name:	boa_priority_code
Primary:	False

Required:	False
Unique:	False
Fields:	boa_priority_code, Ascending

NIIN	1
Clustered:	False
Distinct Count:	2354
Foreign:	False
Ignore Nulls:	False
Name:	NIIN
Primary:	False
Required:	False
Unique:	False
Fields:	NIIN, Ascending
repair_res_code	1
Clustered:	False
Distinct Count:	252
Foreign:	False
Ignore Nulls:	False
Name:	repair_res_code
Primary:	False
Required:	False
Unique:	False
Fields:	repair_res_code, Ascending

Table: tbl_Analysis

Columns

Data Element	Type	Size
NIIN	Text	9
MinMonth	Text	50
MinDateDataPulled	Date/Time	8
MaxMonth	Text	50
MaxDateDataPulled	Date/Time	8
TotalHrs	Number (Long)	4
TotalIncidents	Number (Long)	4
MICAP_Yes_no	Yes/No	1
MICAP_WeaponSystems	Text	255
MICAP_Count_WeaponSystems	Number (Long)	4
NbrMICAP_x_DLA_UP	Currency	8
DLA_QFD	Number (Double)	8
DLA_DESCRIPT	Text	50
DLA_UnitPrice	Currency	8
DLA_Record_Yes_No	Yes/No	1
DLA_NoPR_NoContract_YesNo	Yes/No	1

DLA_NoStock_Yes_No	Yes/No	1
DLA_AAC_Z_Yes_No	Yes/No	1
DLA_AAC	Text	1
WeaponSystemNomenclature	Text	255
CountofWeaponSystems	Number (Long)	4
OH_IA	Number (Double)	8
BO_BB	Number (Double)	8
BO_BV	Number (Double)	8
CONT_DUE	Number (Double)	8
PR_DUE	Number (Double)	8
G005M_09_Yes_no	Yes/No	1
G005M_09_EIID_Count	Number (Long)	4
G005M_09_EIIDs	Memo	-
G005M_09_Operations	Memo	-
G005M_09_OperationsCount	Number (Long)	4
G005M_23_Yes_no	Yes/No	1
EXPRESS_Supportability_Yes_No	Yes/No	1
EXPRESS_Supportability_Failure_Yes_No	Yes/No	1
EXPRESS_BOM_Yes_No	Yes/No	1
EXPRESS_BOM_EndItems	Memo	-
EXPRESS_BOM_CountofEndItems	Number (Long)	4
Retail_SumOfInventory_Balance	Number (Double)	8
Retail_SumOfDDR	Number (Double)	8
Retail_QDR	Number (Double)	8
Retail_QDR_Integer	Number (Integer)	2
Retail_Data_Yes_No	Yes/No	1
Retail_Nbr_SRANs	Number (Integer)	2
Retail_SRANs	Memo	-
Retail_date_of_data	Date/Time	8

Table Indexes

Name	Number of Fields
PrimaryKey	1
Clustered:	False
Distinct Count:	35097
Foreign:	False
Ignore Nulls:	False
Name:	PrimaryKey
Primary:	True
Required:	True
Unique:	True
Fields:	NIIN, Ascending

Table: tbl_Analysis_Retail_RqmntShift

Columns

Data Element	Type	Size
NIIN	Text	9
Comp1_Date	Date/Time	8
Comp2_Date	Date/Time	8
Comp1_SumofDDR	Number (Double)	8
Comp2_SumofDDR	Number (Double)	8
Comp1_QDR	Number (Long)	4
Comp2_QDR	Number (Long)	4
Comp1_Dollars	Currency	8
Comp2_Dollars	Currency	8
DLA_UP	Text	50
DateofDLA_UP	Date/Time	8
DLA_Record	Yes/No	1
COMMENTS	Text	255
DELTA_Dollars	Currency	8
Delta_Units	Number (Long)	4
NoComp1_YesNo	Yes/No	1
NoComp2_YesNo	Yes/No	1

Table Indexes

Name	Number of Fields
PrimaryKey	1
Clustered:	False
Distinct Count:	26436
Foreign:	False
Ignore Nulls:	False
Name:	PrimaryKey
Primary:	True
Required:	True
Unique:	True
Fields:	NIIN, Ascending

Table: tbl_DLA_Data

Columns

Data Element	Type	Size
FSC	Text	4
NIIN	Text	9
OH_IA	Number (Double)	8
BO_BB	Number (Double)	8

BO_BV	Number (Double)	8
CONT_DUE	Number (Double)	8
PR_DUE	Number (Double)	8
EC	Text	1
AAC	Text	1
SSC	Text	1
FSSC	Text	1
ORC	Text	2
ICC	Text	1
ALT	Number (Double)	8
PLT	Number (Double)	8
LAST_DMD	Date/Time	8
QFD	Number (Double)	8
NSO	Number (Double)	8
SLQ	Number (Double)	8
ROP	Number (Double)	8
PRICE	Number (Double)	8
DESCRIPT	Text	50
MGT_ASSMD	Date/Time	8
UI	Text	2
IC_NSN	Text	1
WSD	Text	2
SVC	Text	1
IMM	Text	3
WSCNT	Number (Double)	8
DSC	Text	1
Date_of_Data	Date/Time	8
Qrtly_Forecast_Dollars	Currency	8
CommonItem_Yes_No	Yes/No	1

Table: tbl_DLA_WeaponSystemCodes

<u>*Columns*</u>

Data Element	**Type**	**Size**
Downloaded	Number (Double)	8
WSSC	Text	255
WeaponSystemCategory	Text	255
WeaponSystemNomenclature	Text	255
WSD	Text	2
SVC	Text	1
Qrtly_Fcast_TotalDollars	Currency	8
Nbr_TotalUnits	Number (Long)	4
Nbr_LineItems	Number (Long)	4

Table Indexes

Name	Number of Fields
NumberOfParts	1
Clustered:	False
Distinct Count:	1
Foreign:	False
Ignore Nulls:	False
Name:	NumberOfParts
Primary:	False
Required:	False
Unique:	False
Fields:	Nbr_TotalUnits, Ascending
PrimaryKey	1
Clustered:	False
Distinct Count:	33
Foreign:	False
Ignore Nulls:	False
Name:	PrimaryKey
Primary:	True
Required:	True
Unique:	True
Fields:	WSD, Ascending

Table: tbl_G005M_04_Records

Columns

Data Element	Type	Size
ALC	Text	2
Repeating_group	Text	2
Responsible_engineer	Text	6
Job_Number	Text	6
Operation_Number	Text	5
Filler_1	Text	1
End_Item_Identity	Text	15
Occurance_Factor	Number (Long)	4
Filler_2	Text	4
Date_of_Last_Usage_Analysis	Text	5
BOM_Date_Established	Text	5
Total_Quarterly_Production	Text	56
Prod_Qtr_1	Number (Long)	4
Prod_Qtr_2	Number (Long)	4
Prod_Qtr_3	Number (Long)	4
Prod_Qtr_4	Number (Long)	4
Prod_Qtr_5	Number (Long)	4

Prod_Qtr_6	Number (Long)	4
Prod_Qtr_7	Number (Long)	4
Prod_Qtr_8	Number (Long)	4
PAQ	Text	3
RGC	Text	1
Index	Text	2
Out_of_Bounds	Text	1
D049_JD	Text	1
FIller_3	Text	44

Table: tbl_G005M_09_Records

Columns

Data Element	**Type**	**Size**
ALC	Text	2
Repeating_group	Text	2
Responsible_engineer	Text	6
Job_Number	Text	6
Operation_Number	Text	5
End_Item_Identity	Text	15
Component_NSN	Text	15
Component_NIIN	Text	9
Sort_Code_2	Text	1
Filler_1	Text	9
UPA_QPI	Text	3
Standard_Replacement_Percent	Text	3
Cost_Code	Text	1
Current_Quarterly_Issues	Number (Long)	4
Iss_Qrt_2	Number (Long)	4
Iss_Qrt_3	Number (Long)	4
Iss_Qrt_4	Number (Long)	4
Iss_Qrt_5	Number (Long)	4
Iss_Qrt_6	Number (Long)	4
Iss_Qrt_7	Number (Long)	4
Iss_Qrt_8	Number (Long)	4
Filler_2	Text	35
Date_of_Last_Action	Text	5
Date_Established	Text	5
Analysis_Code	Text	1
Actual_Replacement_Percent	Text	4
Reason_Code	Text	1
Responsible_Cost_Center	Text	6
MIC	Text	2
Utility_Code	Text	1

Non_Support_Code	Text	1
Material_Classification_Code	Text	1
Filler_3	Text	2
Unit_of_Issue	Text	2
ERRC	Text	1
Procurement_Source_Code	Text	1
Unit_Price	Currency	8
Acquisition_Advice_Code	Text	1
SOS	Text	3
Average_Replacement_Cost	Currency	8
Filler_4	Text	6
Budget	Text	1
Sensitive_Item	Text	1
InS	Text	1
Common_Item	Text	1
InS_Code	Text	1
InS_Link	Text	3
DLA_Record_Yes_No	Yes/No	1

Table Indexes

Name	Number of Fields
Acquisition_Advice_Code	1
Clustered:	False
Distinct Count:	21
Foreign:	False
Ignore Nulls:	False
Name:	Acquisition_Advice_Code
Primary:	False
Required:	False
Unique:	False
Fields:	Acquisition_Advice_Code, Ascending
Analysis_Code	1
Clustered:	False
Distinct Count:	5
Foreign:	False
Ignore Nulls:	False
Name:	Analysis_Code
Primary:	False
Required:	False
Unique:	False
Fields:	Analysis_Code, Ascending
Cost_Code	1
Clustered:	False
Distinct Count:	12

	Foreign:	False
	Ignore Nulls:	False
	Name:	Cost_Code
	Primary:	False
	Required:	False
	Unique:	False
	Fields:	Cost_Code, Ascending
InS_Code		1
	Clustered:	False
	Distinct Count:	6
	Foreign:	False
	Ignore Nulls:	False
	Name:	InS_Code
	Primary:	False
	Required:	False
	Unique:	False
	Fields:	InS_Code, Ascending
Material_Classification_Code		1
	Clustered:	False
	Distinct Count:	3
	Foreign:	False
	Ignore Nulls:	False
	Name:	Material_Classification_Code
	Primary:	False
	Required:	False
	Unique:	False
	Fields:	Material_Classification_Code, Ascending
Non_Support_Code		1
	Clustered:	False
	Distinct Count:	1
	Foreign:	False
	Ignore Nulls:	False
	Name:	Non_Support_Code
	Primary:	False
	Required:	False
	Unique:	False
	Fields:	Non_Support_Code, Ascending
Procurement_Source_Code		1
	Clustered:	False
	Distinct Count:	14
	Foreign:	False
	Ignore Nulls:	False
	Name:	Procurement_Source_Code
	Primary:	False
	Required:	False

Unique:	False
Fields:	Procurement_Source_Code, Ascending

Reason_Code 1

Clustered:	False
Distinct Count:	10
Foreign:	False
Ignore Nulls:	False
Name:	Reason_Code
Primary:	False
Required:	False
Unique:	False
Fields:	Reason_Code, Ascending

Utility_Code 1

Clustered:	False
Distinct Count:	6
Foreign:	False
Ignore Nulls:	False
Name:	Utility_Code
Primary:	False
Required:	False
Unique:	False
Fields:	Utility_Code, Ascending

Table: tbl_G005M_23_Records

Columns

Data Element	**Type**	**Size**
ALC	Text	2
Repeating_group	Text	2
Responsible_engineer	Text	6
Job_Number	Text	6
Operation_Number	Text	5
End_Item_Identity	Text	15
EI_Component_Stock_Number	Text	15
EI_Component_NIIN	Text	9
Sort_Code_3	Text	1
Manufacturer_Part_Number	Text	15
Fed_SupplyCode_For_Mgrs	Text	5

Table: tbl_ListofAACs

Columns

Data Element	Type	Size
AAC	Text	1
AAC_Decription	Text	255

Table Indexes

Name	Number of Fields
PrimaryKey	1
Clustered:	False
Distinct Count:	26
Foreign:	False
Ignore Nulls:	False
Name:	PrimaryKey
Primary:	True
Required:	True
Unique:	True
Fields:	AAC, Ascending

Table: tbl_Retail_Data

Columns

Data Element	Type	Size
SRAN	Text	6
NIIN	Text	11
Inventory_Balance	Number (Long)	4
DDR	Number (Double)	8
DDR_Blank_Yes_No	Yes/No	1
Date_of_Data	Date/Time	8

Table Indexes

Name	Number of Fields
PrimaryKey	2
Clustered:	False
Distinct Count:	220575
Foreign:	False
Ignore Nulls:	False
Name:	PrimaryKey
Primary:	True
Required:	True

Unique:	True
Fields:	SRAN, Ascending
NIIN, Ascending	

Summary

This appendix was included to facilitate the re-creation of the research. By requesting the same data elements, tables and data from the applicable organizations, the research can be re-created to substantiate the findings, tables and results. Last, this appendix provides some insight into the complex nature of data integration and the importance of data fidelity. With so many data elements being tracked against so many items (literally millions and millions of items), the importance of having viable seamless interfaces and valid data becomes increasingly important as DoD resources diminish.

Appendix E

Appendix E. MICAP Policies and Procedures

AFMAN 23-110, Vol II, Part 2, Chapter 17

The following excerpts are directly cited from AFMAN 23-110, Vol II, Part 2, Chapter 17. This information highlights the significance of a MICAP requisition and the level of urgency the requirement should receive throughout the logistics chain. Furthermore, it provides additional insight as to how MICAP hours are measured.

17.1. Chapter Summary. This chapter explains how to acquire and report on parts needed on a high or highest priority basis. MICAP procedures are used to secure materiel needed to repair mission essential equipment of the highest priority. The MICAP system provides a method of obtaining the kinds of items required by AF organizations to maintain mission capability. For this reason, all personnel involved in the MICAP system should be familiar with all of the procedures see **Section 17A**.

17.2. Overview

17.2.1. Section Summary. …The reporting of MICAP requirements is based on a start/stop concept; the report period starts at the time the item is requisitioned and stops at the time of termination. Termination can result from the item being due-out released or the requirement being downgraded or canceled. The system provides for automated error corrections. It permits interrogations from AFMC on the status of a MICAP requirement. The system provides AFMC with information on requisition supply status bases receive from other sources.

17.2.2. Use of MICAP Procedures. MICAP is to be used only after all efforts are made to resolve materiel shortage problems through other local resources. A check of all base level resources must be carried out before MICAP requisitions are initiated.

17.2.3. Intensive Management. Once a MICAP requisition is initiated, managers at all levels are required to intensively manage the MICAP requisition and reporting system.

………..

17.3. Base-Level Materiel Search. Before a MICAP requisition is submitted, Supply and Maintenance personnel must ensure that all possible base-level resources are exhausted….A MCIAP condition will be confirmed at base level only after Maintenance verifies that the end item is not mission capable and both Supply and Maintenance personnel verify that the requirement cannot be satisfied using base level resources.

17.4. Initiation of MICAP Requisitions

17.4.1 Issue Request. When the initial materiel search has been carried out and it is certain that the item is not available through base resources, a MICAP condition can be confirmed at base level…..If the SRD is MICAP reportable, this input will generate a MICAP requisition and a MICAP report.

………..

17.6 MICAP Termination and MICAP Suspense Record

17.6.1. MICAP Termination. A MICAP is terminated at the time of a due-out release, due-in or due-out cancellation, or downgraded to non-MICAP.

Attachment 17A-14. MICAP DUE-OUT CAUSE CODE

The purpose of MICAP cause codes is to determine the conditions that exist at the time of the MICAP. Does AFMC policy prohibit an item from being stocked? Is the source of supply delinquent in filling a stock replenishment requisition, thus leaving the base unprepared to fill a customer request? This table from AFMAN 23-110, Vol II, Part 2, Chapter 17 provides some insight on how MICAP conditions arise.

Table 36. AFMAN 23-110, Vol II, Part 2, Chapter 17, Table 17A14.1. Cause Code.

Code	Explanation
	Non-Stocked Items
A	No stock level established – No demand or reparable generation before this request. This code is assigned to change/transfer/or stop reports under program control when type stock record account is E or K.
B	No stock level established – Past demand or reparable generation experience but AF base stockage policy precluded establishing level.
C	AFMC/SPM/IMS has determined the item should not be stocked at base level.
D	Base decision not to stock the item.
	Stocked Items
F	Full base stock – Depth of stock insufficient to meet MICAP/due-out requirement.
G	Full base stock – Quantity necessary for requirement is in AWP status.
H	Less than full base stock – Stock replenishment requisition exceeds priority group UMMIPS standards
J	Less than full base stock – Stock replenishment requisition does not exceed priority group UMMIPS standards. **NOTE:** This cause code will also be assigned when a routine due-out has been manually linked to a stock

	replenishment due-in and a MICAP condition occurs. The due-in is no longer recognized as stock replenishment due-in.
K	Less than full base stock – No stock replenishment due-in established.
R	Full base stock – Assets cannot be used to satisfy this requirement, that is, deployed MSK, inaccessible supply point balance, or otherwise unavailable.
S	Less than full base stock. Stock replenishment requisition exceeds UMMIPS time standards by priority group and AWP assets on hand at time of MICAP.
T	Less than full base stock. Stock replenishment requisition does not exceed UMMIPS time standards by priority group and AWP assets on hand at time of MICAP.
X	Less than full base stock. No due-in established and AWP assets on hand at time of MICAP.
	Special Purpose
Y	Data not available on manually prepared START reports due to ADPS being inoperative for unscheduled maintenance.
Z	System/Commodity received without MICAP item (initial shortage).
1-6	Command Unique

Appendix F.

Appendix F. Premium vs. Routine Transportation Model

$$\frac{\text{One - time Reduction in Inventory Value Resulting From Fast Trans}}{(\text{Annual Increased Cost of Fast Trans}) - (\text{Annual Decrease in Holding Cost from Fast Trans})}$$

or, symbolically,

$$\frac{UP * (SLQ_{SLOW} - SLQ_{FAST})}{\left[\left(\frac{365 * DDR}{EOQ}\right) * (Trans_{\Pr em} - Trans_{Rout})\right] - [(UP) * (HCF) * (SLQ_{SLOW} - SLQ_{FAST})]}$$

Data Elements of the Premium Transportation Model

Table 37 lists the major components of the Premium Transportation Model.

Table 37. Components of the Premium Transportation Model

Data Element	Acronym
Average Cost of Premium Transportation	$Trans_{\Pr em}$
Average Cost of Routine Transportation	$Trans_{Rout}$
Daily Demand Rate	DDR
Economic Order Quantity	EOQ
Holding Cost Factor	HCF
Safety Level Quantity if Premium Transportation is Used for Stock Replenishment Requisition	SLQ (Fast)
Safety Level Quantity if Routine Transportation is Used for Stock Replenishment Requisition	SLQ (Slow)
Unit Price	UP

Explanation of Terms

Table 38. Explanations of Each Component of the Premium Transportation Model

Term/Variable	Meaning
SLQ_{SLOW}	A safety level which is computed using Priority Group 3 receipt values for the O&ST and VOO; in general, the receipts that fall into this group have been moved using routine transportation
SLQ_{FAST}	A safety level which is computed using Priority Group 1 & 2 receipt values for the O&ST and VOO; in general, the receipts that fall into this group have been moved using express transportation
$SLQ_{SLOW} - SLQ_{FAST}$	The expected reduction in the safety level (expressed in units of stock) if express transportation was used for all stock replenishment requisitions for the given item
$Unit\,\mathrm{Pr}ice * (SLQ_{SLOW} - SLQ_{FAST})$	Monetary reduction in inventory if express transportation was used for all stock replenishment requisitions for the given item
365*DDR	Expected annual demand
EOQ	Optimized order quantity based on the expected annual demand
$\left(\frac{365 * DDR}{EOQ}\right)$	The expected number of orders that will be placed during the year based on the expected annual demand
$Trans_{\mathrm{Pr}em} - Trans_{Rout}$	This yields the delta in the average cost of Premium Transportation shipments and Routine Transportation shipments.

Term/Variable	Meaning
$\left[\left(\frac{365 * DDR}{EOQ}\right) * (Trans_{Prem} - Trans_{Rout})\right]$	The expected number of orders placed in a year, multiplied by the difference in average transportation costs, yields the expected additional annual transportation cost that would be incurred if all replenishment orders were moved with express transportation for the given item
$\left[(Unit\,Price) * (HoldCostFactor) * (SLQ_{SLOW} - SLQ_{FAST})\right]$	This computation yields the expected additional annual holding costs if all replenishment orders were moved with routine transportation for the given item
$\left[\left(\frac{365 * DDR}{EOQ}\right) * (Trans_{Prem} - Trans_{Rout})\right] - \left[(Unit\,Price) * (HoldCostFactor) * (SLQ_{SLOW} - SLQ_{FAST})\right]$	This computation yields the delta in variable transportation and holding costs. A negative (-) value suggests that it is less expensive in the aggregate to move items with express transportation than it is to store the additional safety level if those same shipments were moved with routine transportation. Conversely, a positive resultant suggests that moving the replenishment orders with express transportation will increase transportation costs without a counter-reducing effect in holding costs. If the resultant is zero (0), then the model suggests that replenishment orders may be moved with express transportation, and that holding costs will drop to correspond with the increase in transportation costs.

Term/Variable	**Meaning**
$\frac{Unit\ Price * (SLQ_{SLOW} - SLQ_{FAST})}{\left[\left(\frac{365 * DDR}{EOQ}\right) * (Trans_{Prem} - Trans_{Rout})\right] - \left[(Unit\ Price) * (HoldCostFactor) * (SLQ_{SLOW} - SLQ_{FAST})\right]}$	This computation yields the number of years of expected benefit derived from moving replenishment orders with express transportation. Since the numerator is a one-time savings in inventory reduction, and the denominator reflects the potential increase or decrease in the sum of variable holding and transportation costs, in concert, a positive quotient reflects the diminishing point at which increased variable costs will have consumed any monetary benefits derived from inventory reductions.

Glossary

This glossary contains alphabetical lists of the acronyms and technical terms found in this research.

Acronyms

A/C	Aircraft
AAC	Acquisition Advice Code
ACSC	Air Command & Staff College
AF	Air Force
AFMAN	Air Force Manual
ALC	Air Logistics Center
ALT	Administrative Lead-time
AFLMA	Air Force Logistics Management Agency
AFMC	Air Force Materiel Command
AWP	Awaiting Parts
BO	Backorder
BOM	Bill of Materiel
BRAC	Base Realignment And Closure
DB	Database
DDP	Date Data Pulled
DDR	Daily Demand Rate
DRID	Defense Reform Initiative Directive
DLA	Defense Logistics Agency
DMRT	Defense Management Review Team
DoD	Department of Defense
EAF	Expeditionary Air Force
EIID	End-Item Identity
EOQ	Economic Order Quantity
EXPRESS	Execution and Prioritization of Repair Support System
HCF	Holding Cost Factor
I&SG	Interchangeable & Substitute Grouping

IMS	Item Management Specialist
MDS	Mission Design Series
MICAP	Mission Capable
MS	Microsoft
MSK	Mission Support Kit
NMCS	Not Mission Capable Supply
NIIN	National Item Identification Number
O&ST	Order & Ship Time
O&STQ	Order & Ship Time Quantity
OC	Oklahoma City
OC-ALC	Oklahoma City Air Logistics Center
OH	On-Hand
OO	Ogden
OO-ALC	Ogden Air Logistics Center
PDM	Programmed Depot Maintenance
PLT	Procurement Lead-time
PMCS	Partial Mission Capable Supply
PR	Purchase Request
QDR	Quarterly Demand Rate
QFD	Quarterly Forecast Demand
RAM	Random Access Memory
SA	San Antonio
SA-ALC	San Antonio Air Logistics Center
SBSS	Standard Base Supply System
SLQ	Safety Level Quantity
SM	Sacramento
SM-ALC	Sacramento Air Logistics Center
SMART	Systems Management Analysis Reporting Tool
SOS	Source of Supply
SPM	System Program Manager
SQL	Structured Query Language
SRAN	Stock Record Account Number
SRD	System Reporting Designator
TCTO	Time Change Technical Order
UMMIPS	Uniform Military Movement & Issue Prioritization System
UP	Unit Price
USAF	United States Air Force

VOD	Variance of Demand
VOO	Variance of Order & Ship Time
WR	Warner Robins
WR-ALC	Warner Robins Air Logistics Center
WS	Weapon System
WSSP	Weapon System Support Program

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